NAVSHIPS 91152

36

INSTRUCTION BOOK

for

RADIO TELETYPE TERMINAL SET AN/SGC-1

REMLER COMPANY, LTD.
SAN FRANCISCO, CALIFORNIA

BUREAU OF SHIPS

NAVY DEPARTMENT

Copy
Code 330

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Contract: NObsr 39323 *Approved by BuShips: 10 December 1948*

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BUREAU OF SHIPS

REFER TO FILE NO.

NAVY DEPARTMENT
BUREAU OF SHIPS
WASHINGTON 25, D. C.

10 December 1948

Code 993-100

To: All Activities concerned with the Installation, Operation and Maintenance of the Subject Equipment.

Subj: Instruction Book for Radio Teletype Terminal Set AN/SGC-1 (NAVSHIPS 91152)

1. NAVSHIPS 91152 is the instruction book for the subject equipment and is in effect upon receipt.

2. When superseded by a later edition, this publication shall be destroyed.

3. Extracts from this publication may be made to facilitate the preparation of other Navy instruction books and handbooks.

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E. W. MILLS
Chief of Bureau

FROM BUREAU OF SHIPS, NAVY DEPARTMENT, WASHINGTON 25, D. C.

RECORD OF CORRECTIONS MADE

CHANGE NO.	DATE	SIGNATURE OF OFFICER MAKING CORRECTION

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GUARANTEE

The Contractor guarantees that at the time of delivery thereof the articles provided for under this contract will be free from any defects in material or workmanship and will conform to the requirements of this contract. Notice of any such defect or non-conformance shall be given by the Government to the Contractor within one year of the delivery of the defective or nonconforming article, unless a different period of Guaranty is specified in the schedule. If required by the Government within a reasonable time after such notice, the Contractor shall with all possible speed correct or replace the defective or non-conforming article or part thereof. When such correction or replacement requires transportation of the article or part thereof, shipping costs, not exceeding usual charges, from the delivery point to the Contractor's plant and return, shall be borne by the Contractor; the Government shall bear all other shipping costs. This Guaranty shall then continue as to corrected or replacing articles or, if only parts of such articles are corrected or replaced, to such corrected or replacing parts, until one year after the date of redelivery, unless a different period of Guaranty is specified in the schedule. If the Government does not require correction or replacement of a defective or non-conforming article, the Contractor, if required by the contracting officer within a reasonable time after the notice of defect or non-conformance, shall repay such portion of the contract price of the article as is equitable in the circumstances.

INSTALLATION RECORD

Contract Number: NObsr 39323 Date of Contract: 26 June 1947

Serial Number of equipment.....

Date of acceptance by the Navy.....

Date of delivery to contract destination.....

Date of completion of installation.....

Date placed in service.....

Blank spaces in this table shall be filled in at time of installation.

REPORT OF FAILURE

Report of failure of any part of this equipment, during its service life, shall be made to the Bureau of Ships in accordance with current regulations using form NAVSHIPS NBS383. The report shall cover all details of the failure and give the date of installation of the equipment. For procedure in reporting failures see Chapter 67 of the *Bureau of Ships Manual* or superseding instructions.

ORDERING PARTS

All requests or requisitions for replacement material should include the following data:

1. Federal stock number or, when ordering from a Marine Corps or Signal Corps supply depot, the Signal Corps stock number.
2. Name and short description of the part.

If the appropriate stock number is not available the following shall be specified:

1. Equipment model or type designation, circuit symbol, and item number.
2. Name of part and complete description.
3. Manufacturer's designation.
4. Contractor's drawing and part number.
5. JAN or Navy type number.

SAFETY NOTICE

The attention of officers and operating personnel is directed to Chapter 67 of the *Bureau of Ships Manual* or superseding instruction on the subject of radio-safety precautions to be observed.

This equipment employs voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment.

RESUSCITATION

AN APPROVED POSTER ILLUSTRATING THE RULES FOR RESUSCITATION BY THE PRONE PRESSURE METHOD SHALL BE PROMINENTLY DISPLAYED IN EACH RADIO, RADAR, OR SONAR ENCLOSURE. POSTERS MAY BE OBTAINED UPON REQUEST TO THE BUREAU OF MEDICINE AND SURGERY.

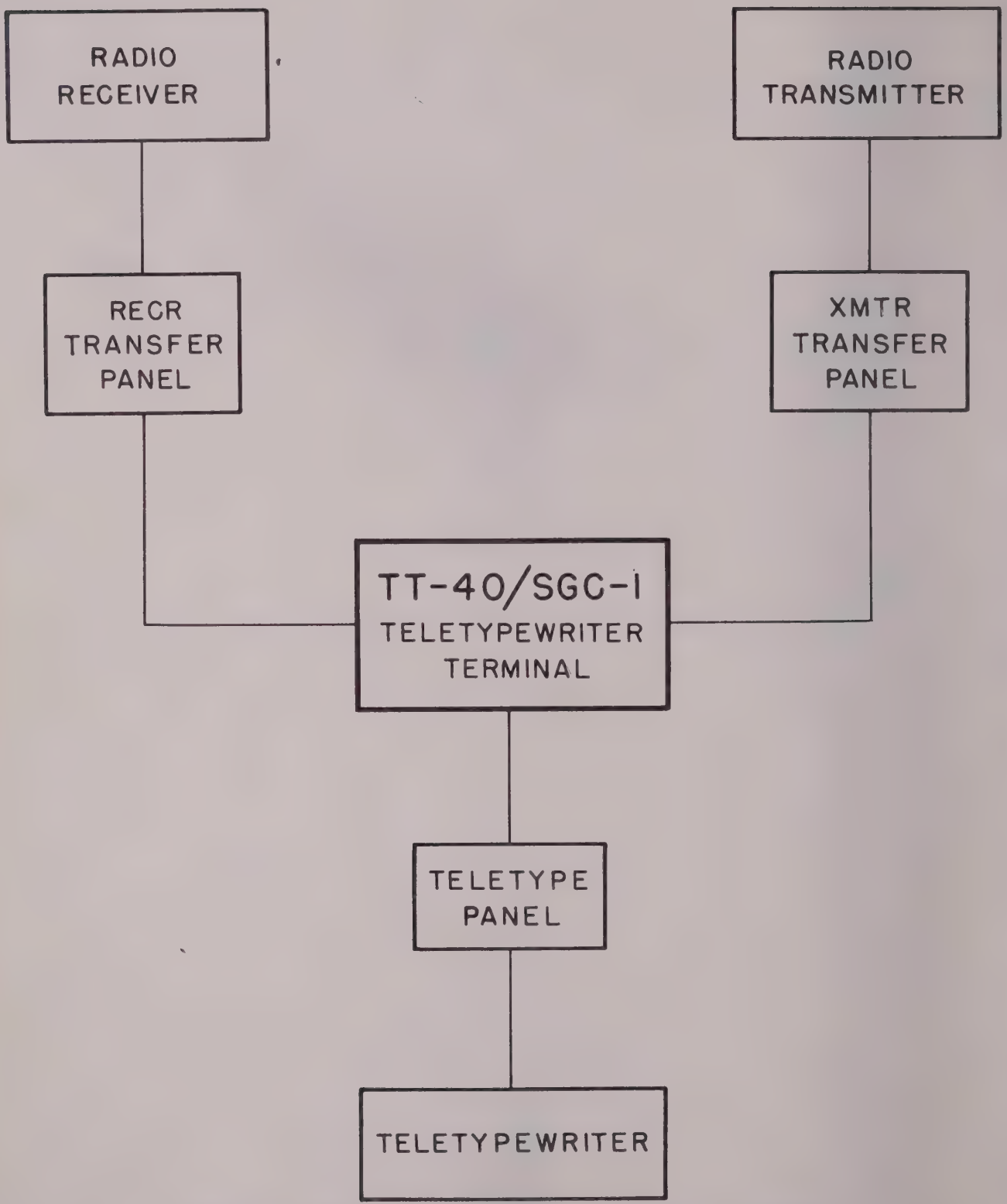


Figure 1—1. Teletypewriter Terminal TT-40/SGC-1 and Connections to Associated Radio Telephone Equipment

SECTION 1
GENERAL DESCRIPTION

1. EQUIPMENT ILLUSTRATIONS.

The drawing on the facing page, Fig. 1—1, shows the related connections between the AN/SGC-1 Radio Teletype Terminal Set and associated radio-telephone and teletypewriter equipment. The radio units as well as the teletypewriter units are shown as generalized blocks to denote that any standard Navy components may be utilized. The AN/SGC-1 Set consists of the TT-40/SGC-1 Teletypewriter Terminal and its repair parts and instruction books.

2. PURPOSE AND BASIC PRINCIPLES.

The purpose of the TT-40/SGC-1 Terminal is to make possible the transmission and reception of teletypewriter messages by radio communication between stations similarly equipped.

When transmitting messages, typing on the local teletypewriter causes a direct current series loop to intermittently open, thus forming pulses of current. Each letter has its own characteristic pattern of current pulses. These pulses are converted by the local Teletypewriter Terminal into corresponding audio tones which modulate the local voice-frequency radio transmitter. Conversion of the current pulses to audio tones is accomplished by an audio oscillator, in the Teletypewriter Terminal, which operates at 700 cps when the teletypewriter loop is in a closed circuit condition and at 500 cps when the loop is in an open condition. Hereafter, the closed circuit condition of the loop and its related 700 cps tone will be known as "Mark." The open circuit condition and its related 500 cps tone will be known as "Space". An internal relay of the TT-40/SGC-1 closes a control line to the radio transmitter which places the unit on the air at the instant the operator begins typing the message. This control line remains closed until after the message has been transmitted.

When receiving messages, the TT-40/SGC-1 accepts the Mark and Space tones incoming from an associated radio receiver and converts the intelligence of the tones to a make-and-break contact of a relay connected into the local teletypewriter direct current loop. Thus the local teletypewriter is made to print in unison with the distant teletypewriter.

3. DESCRIPTION OF UNIT.

Fig. 1—2 shows the general appearance of the Teletypewriter Terminal TT-40/SGC-1. In the upper left of the front panel is the REC LEVEL calibrated attenuator. When this control is properly adjusted, the level of the incoming tone signals is set to the required level. Next to the REC LEVEL control is the LOOP CURR rheostat which permits adjustment of the teletypewriter loop current, when in Mark condition, to 60 milliamperes. In the upper middle is a zero-center meter. Below it is the METER SWITCH which has several positions allowing all necessary portions of the circuit to be measured. Flanking the upper part of the meter are two indicator lights. One light is on in RECEIVE condition and the other is on in TRANSMIT condition. Both lights are off when the Terminal is in standby condition. To the right of the meter is the SEND BIAS rheostat which enables correction of any teletype distortion in the local teletypewriter loop. At the far right is a jack marked TTY MONITOR. A test or monitoring teletypewriter may be patched into this jack thus placing it in series with all other equipment in the loop. At the lower left is the POWER indicator light. Next to it is the POWER ON-OFF switch. This switch, when ON, causes the source of 115 Vac power to be applied to the Teletypewriter Terminal unit and also causes the adjacent indicator to light. To the right of the power switch is the REC BIAS potentiometer which enables correction of distortion in the receiving tone circuit. To the right of the METER SWITCH, previously described, is the CONTROL SWITCH which may be set to determine the functioning of the Teletypewriter Terminal. At the lower right is the fused 115 Vac utility outlet. This outlet is directly connected to the power line and is not controlled by the power switch.

On each side are two retaining bolts. When these are loosened, the front panel and chassis assembly may be pulled out on runners and, after reaching the limit of free travel, the chassis may be tilted up to approximately a 90 degree angle thus facilitating inspection and maintenance. The power and external circuits are connected to the outer cabinet by cables and then via flexible cables to the chassis. The chassis may be tested in an operating condition even when tilted up.

Figure 1—2. Teletypewriter Terminal TT-40/SGC-1

TABLE 1—1. EQUIPMENT SUPPLIED

QUAN. PER EQUIP.	NAME OF UNIT	DESIGNATION	OVER-ALL DIMENSIONS†			VOL.†	WEIGHT†
			HEIGHT	WIDTH	DEPTH		
1	Teletypewriter Terminal	TT-40/SGC-1	9 11/16	19 1/4	17 5/16	1.90	50.0
1	Set of Equipment Spare Parts		6 1/8	19 1/8	16	1.08	49.0
2	Instruction Books	NAVSHIPS 91152	11 1/4	8 5/8	3/16	0.01	0.5

TABLE 1—2. EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED

QUANTITY PER EQUIPMENT	NAME OF UNIT	REQUIRED CHARACTERISTICS
1	Radio Transmitter	A-3 emission
1	Radio Receiver	A-3 reception
1 or more	Teletypewriter	Suitable to operate on 60 ma neutral loop

TABLE 1—3. SHIPPING DATA

SHIPPING BOX No.	QUANTITY	CONTENTS		BOX OVER-ALL DIMENSIONS†			VOL.†	WEIGHT†
		NAME OF UNIT	DESIGNATION	HEIGHT	WIDTH	DEPTH		
1	1	Teletypewriter Terminal	TT-40/SGC-1	20 1/2	24 1/4	21 1/4	6.1	148
1	1	Set of Equipment Spare Parts						
1	2	Instruction Books	NAVSHIPS 91152					

† Unless otherwise stated, dimensions are inches, volume cubic feet, weight pounds.

TABLE 1—4. VACUUM TUBE COMPLEMENT

QUANTITY	TUBE TYPE	DESCRIPTION
6	12AU7	Twin Triode Amplifier
2	6AQ5	Beam Power Amplifier
2	5Y3 GT	Full Wave Rectifier
1	OC3/VR105	Voltage Regulator

REFERENCE DATA

a. NOMENCLATURE:	Radio Teletype Terminal Set AN/SGC-1
b. CONTRACT:	NObsr 39323, dated 26 June 1947
c. CONTRACTOR:	Remler Co. Ltd., San Francisco, California
d. COGNIZANT NAVAL INSPECTOR:	Inspector of Naval Material, San Francisco, California
e. NUMBER OF PACKAGES PER COMPLETE SHIPMENT OF EQUIPMENT:	One
f. TOTAL CUBICAL CONTENTS:	6.1 cu. ft., crated 3.6 cu. ft., uncrated } including one spare parts box.
g. TOTAL WEIGHT:	148 lbs., crated 104 lbs., uncrated
h. FREQUENCY:	500 and 700 cycles per second
i. MINIMUM INPUT SIGNAL LEVEL:	—40 dbm
j. MAXIMUM OUTPUT POWER:	+10 dbm
k. OUTPUT IMPEDANCE:	600/50 ohms
l. INPUT IMPEDANCE:	600 ohms
m. HEAT DISSIPATION:	117 watts
n. POWER SUPPLY FOR TELETYPEWRITER TERMINAL:	115 volts ±10% 50/60 cps ac 1 ampere
o. POWER SUPPLY FOR TELETYPE LOOP:	110 volts dc; 0.060 amperes

SECTION 2
THEORY OF OPERATION

1. GENERAL.

All principal circuits of the TT-40/SGC-1 Teletypewriter Terminal and the representative oscilloscope patterns are shown in the block diagram, Fig. 2—1. At the input of the receive circuit is the attenuator which permits adjustment of the level of the incoming two-tone signal. A band-pass filter circuit then passes audio frequencies that fall between 400 and 800 cps and rejects all other frequencies. Following the filter, are the amplifier-limiter stages which have a constant output level. The oscilloscope view at the output of the amplifier-limiter shows a distorted group of cycles instead of the squared-top signals usually expected. This is due to the reflected losses of the following filters. Then the frequency discriminator filters select the fundamental frequencies, 500 and 700 cps, and route them to two germanium rectifiers which in turn apply the rectified dc to a direct current amplifier. This amplifier is connected so as to cause the receive relay to close its contacts when the incoming signal is 700 cps and to open its contacts when the incoming signal is 500 cps. The 700 cps signal and the related closed circuit condition are known as "MARK". The 500 cps signal and its related open circuit condition are known as "SPACE". One set of contacts of the receive relay is in series with the teletypewriter closed series loop consisting of one or more teletypewriters, some series resistance, a "battery" or other 110 Vdc source, and one winding of the send relay. Consequently, the receive relay is able to open and close the local teletypewriter loop thus forming current pulse patterns in this loop identical to those in the transmitting teletypewriter loop.

The teletypewriters to be used with the Terminal must be types that operate on a normally closed line having a current of 60 milliamperes. These teletypewriters have the selector magnet and the keyboard contacts wired in series in the teletypewriter loop. If the loop current remains steady, the teletypewriter will sit idle. But if the loop current is broken by action external to the teletypewriter machine, the closed keyboard contacts in the machine permit the selector magnet to operate properly and cause the incoming message to be printed on the paper. Messages may be handled only by Half Duplex (H-DX) operation, that is, only one direction at a time.

Since the keyboard contacts and the selector magnet are wired in series the message is also printed on the paper as

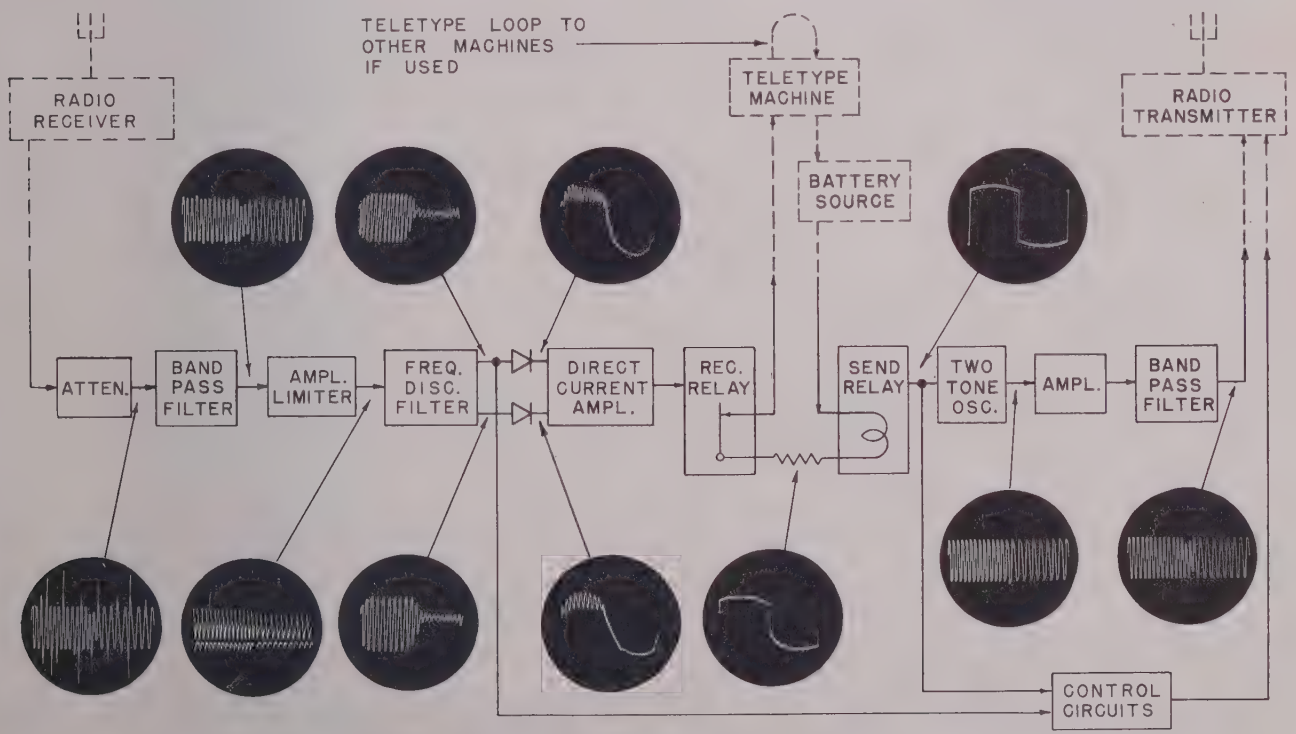


Figure 2—1. System Block Diagram

it is typed so that the operator may check and correct for errors in his typing. Depressing the keys breaks the loop current and the send relay of the Teletypewriter Terminal causes a dc voltage to key the two-tone oscillator and the control circuits. An interlock action of the control circuits prevents operation of the send relay when the Teletype Terminal is in the receive condition.

The two-tone oscillator operates at 700 cps when the send relay is in Mark condition and at 500 cps when the relay is in Space condition. The output of the oscillator passes through a level-controlling potentiometer to the amplifier stage. Then the amplified signal is fed through a band-pass filter to the ship radio transmitter.

Control circuits cause the individual sections of the Terminal to be rearranged for the various functions. When the control switch is on AUTO, the Terminal may be in one of three conditions: receiving, transmitting, or standby. When in standby condition, the reception of an incoming Mark tone causes the control circuits to change to receiving. Following the end of the incoming message, the circuits shift back to standby. When in standby condition, the operation of the local teletypewriter's keyboard causes the circuits to change to transmit. After the last letter is keyed, there is a time delay of about three seconds and then the circuits shift back to standby. The interlocking functions purposely prevent the equipment from shifting directly from transmit to receive or vice-versa. Thus, an incoming signal will not interrupt outgoing traffic nor will keying the local machine when receiving cause the circuit to shift to transmit. The control circuits also, when shifted to transmit, cause the control pair to the radio transmitter to close thereby placing the transmitter carrier on the air.

2. INPUT BAND-PASS FILTER CIRCUIT.

Fig. 2—2 shows the band-pass filter with associated circuit. Signals from the radio receiver pass through the 600/600 ohm isolation transformer T-101, to an attenuator E-101, a 6 db pad, and band-pass filter Z-101. The 20 step attenuator inserts two db of loss with each step, thus giving a possible maximum loss of 40 db for strong signals. R-101, R-102, and R-103 form the pad which causes six db attenuation and minimizes the effects of a mismatch, if the receiver does not have a 600 ohm output

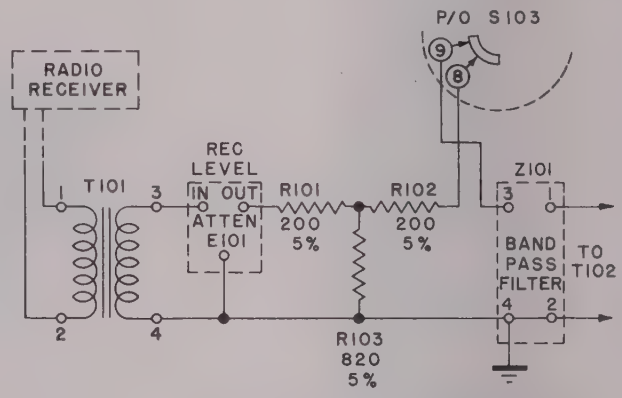


Figure 2—2. Band-Pass Filter and Input Circuit

impedance. Otherwise, a serious mismatch would alter the frequency response of the band-pass filter. The filter attenuates the frequencies from 400 to 800 cps no more than two db but greatly attenuates all other frequencies; see curve, Fig. 2—3.

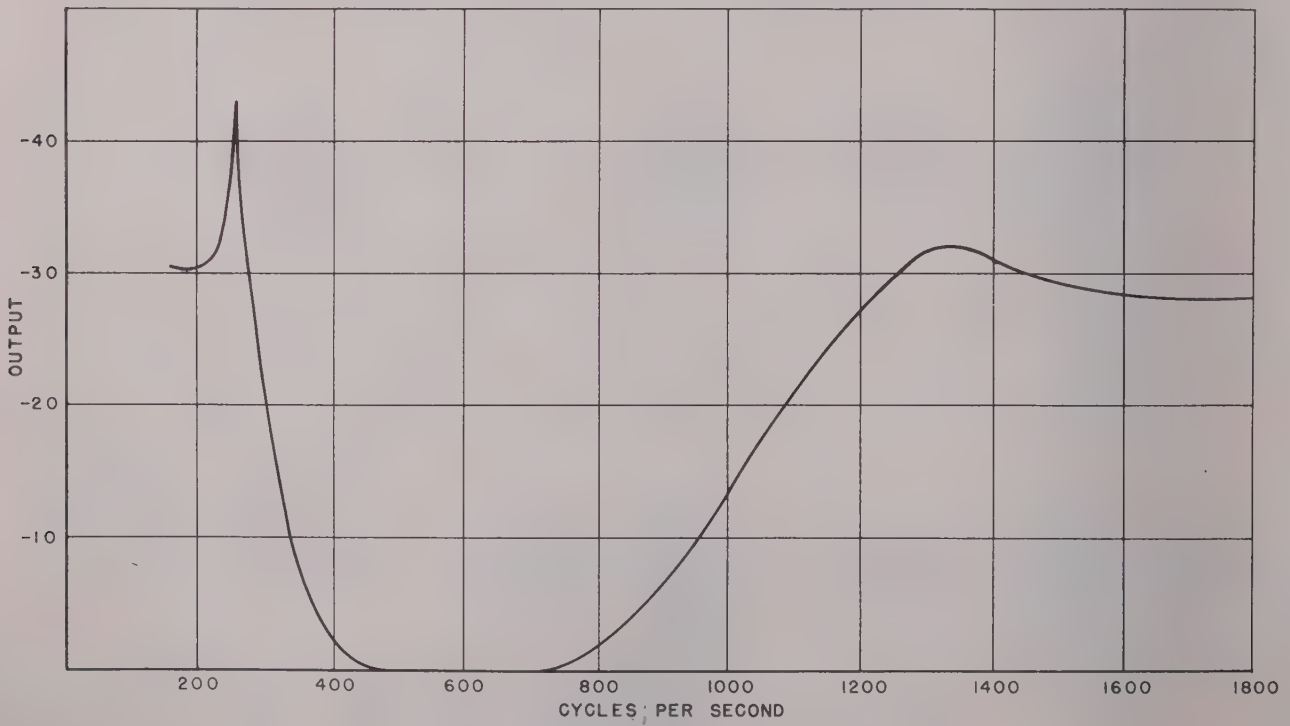


Figure 2—3. Band-Pass Filter Attenuation Curve

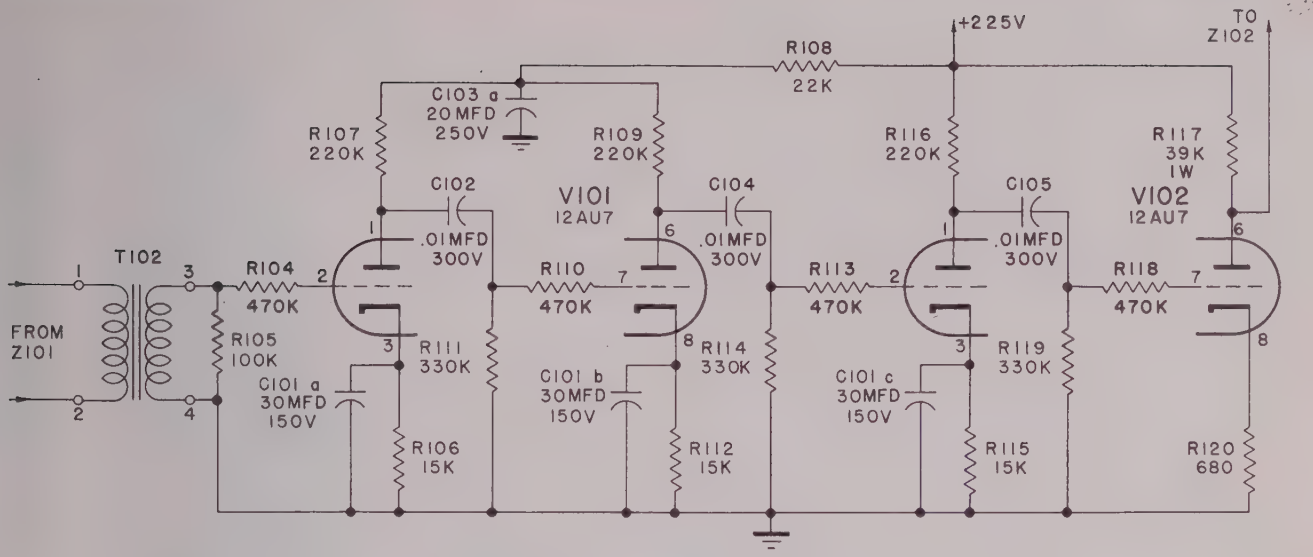


Figure 2—4. Amplifier-Limiter

3. AMPLIFIER-LIMITER.

In the amplifier-limiter shown in Fig. 2—4, transformer T-102 couples the 600 ohm impedance of the preceding filter to the amplifier input grid. This amplifier is a conventional voltage amplifier except that the signal is applied to each grid through a series resistor to secure limiting action. On low signal levels, the series resistor has no affect and the triodes act as amplifiers. On high signal levels the triodes act as limiters because the grids swing negative to the plate current cut-off point, and swing positive until the grids draw current. After the grids reach the point where they draw current, increasing positive half-cycle voltages have no further appreciable effect on plate current because the grid current produces a voltage on the grid series resistor which opposes the signal voltage. The first three stages are identical in circuit constants and operation; however, the fourth stage is modified by different circuit constants to provide proper impedance for the following discriminator filter. To correct for possible discrepancies in the positive and negative halves of the amplified and limited signal, degeneration is obtained by having the cathode resistor unbypassed in this stage.

4. FREQUENCY DISCRIMINATOR FILTER CIRCUIT.

In Fig. 2—5 is shown the frequency discriminator filter Z-102 and its associated circuits. This filter consists of two complimentary band-pass filters in one container. Terminals 1, 2, and 3 connect to the section that passes 700 cps and a narrow band of frequencies above and below that center frequency. Terminals 3, 4, and 5 connect to the section that passes a similar band centering on 500 cps. See attenuation curves, Fig. 2—6. Terminal 3 is common to both sections and terminal 6 is connected to the filter container. The input terminals of the two sections are tied in parallel and connected to the plate of the last limiter V-102B. The internal capacitors of the filters eliminate the need of a coupling capacitor. The Mark tone, 700 cps, appears across terminating resistor R-121 and the Space tone, 500 cps appears across R-124. The two incoming tones from the radio receiver may be at different levels but the amplifier-limiter action causes them to arrive at the discriminator filter at a constant level. The outputs of the filter show either 700 cps or 500 cps but not both frequencies at once. Observation with an oscilloscope reveals that when a Mark tone appears across R-121 (when receiving 700 cps), it also appears with only 12% relative amplitude across the other resistor R-124. Conversely, approximately 12% of the Space tone appears

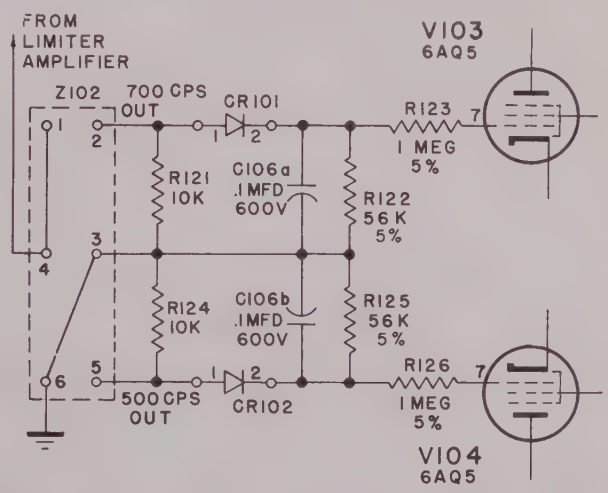


Figure 2—5. Tone Discriminator and Rectifier

across the Mark resistor when the incoming tone is 500 cps. This small amount of leakage tone does not appreciably affect the action of the following stages.

During the time Mark tone is being applied across R-121, the germanium diode CR-101 charges capacitor C-106a, on the positive half-cycles, to approximately 15 volts. During the negative half-cycles, C-106a, loses some

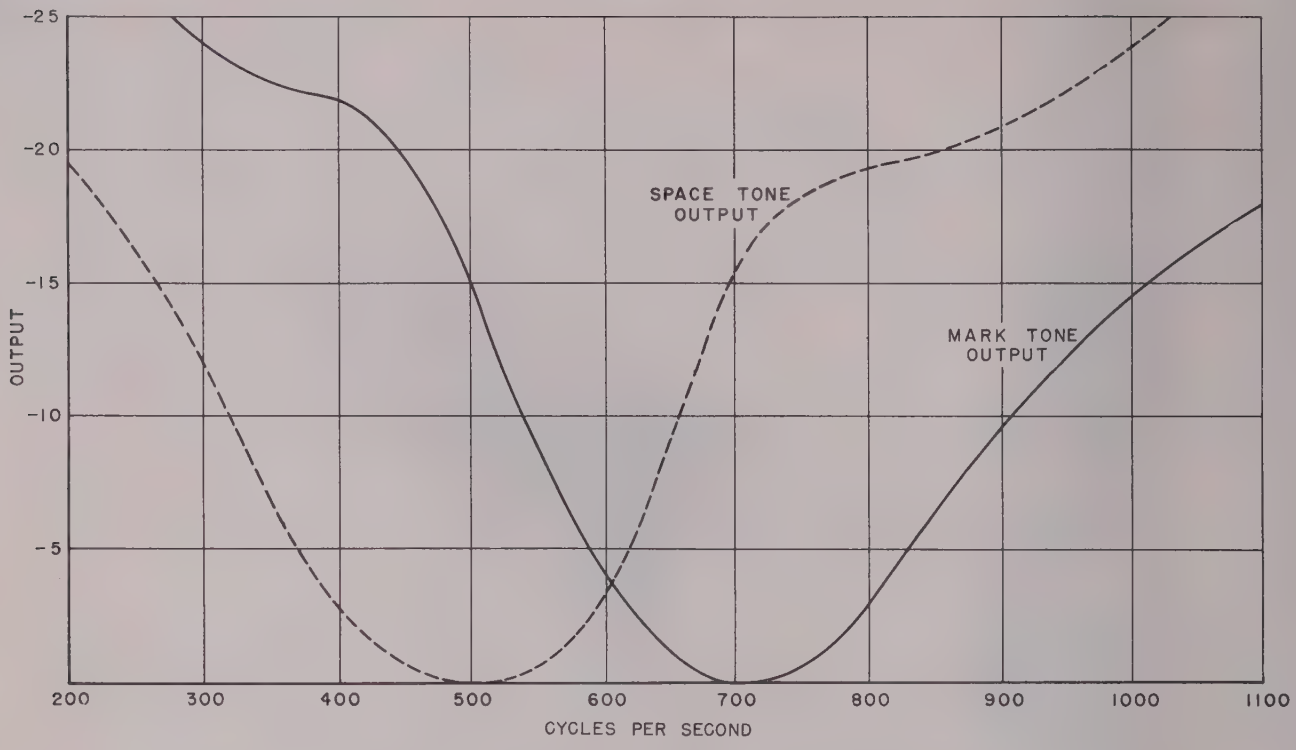


Figure 2—6. Discriminator Filter Attenuation Curves

of its positive charge through R-122. As the discharge resistor R-122 is about six times as large as the charging resistor, the majority of the accumulated charge is retained on C-106a until the end of the Mark tone, at which time C-106a will discharge to zero potential. During the time Space tone is being received, the signal charges C-106b through R-124 and CR-102. C-106b discharges through R-125. The Mark and Space positive impulses are applied to the grids of the dc amplifier tubes, V-103 and V-104, through grid current limiting resistors R-123 and R-126, respectively.

5. DC AMPLIFIER.

The dc amplifier circuit is shown in Fig. 2—7. The cathodes of the pentodes V-103 and V-104 are connected to opposite ends of the REC BIAS potentiometer. The variable tap on the potentiometer is connected to the cathode resistor R-127 so that R-127 is common to both pentodes and tends to equalize the cathode currents. The series screen resistor R-129 drops the voltage to a satisfactory level and tends to equalize the plate currents of the pentodes.

Mark impulses applied through R-123 to the grid of V-103 cause the plate current to increase from approximately two ma to about 22 ma. Space impulses applied through R-126 to the grid of V-104 cause a similar increase in plate current of V-104. The REC BIAS potentiometer is provided to permit changing the relative amplitude of these impluses by varying the magnitude of the pentode plate currents in the following manner. When the REC BIAS potentiometer is rotated in one direction it increases the resistance in one cathode circuit while it decreases the resistance in the other cathode circuit. This action causes the cathode voltage of the first pentode to increase while causing the cathode voltage of the second pentode to decrease. Since the plate current of pentodes is controlled by the grid-to-cathode voltage a change in cathode voltage by the REC BIAS potentiometer is very effective in changing the plate current.

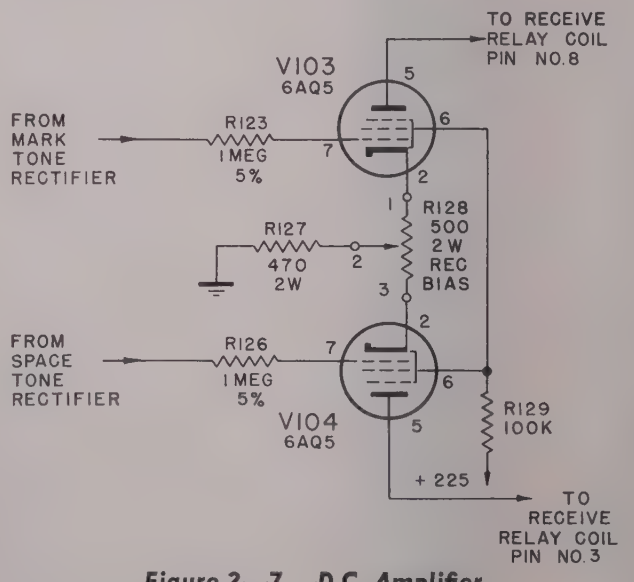


Figure 2—7. D.C. Amplifier

6. RECEIVE RELAY CIRCUIT.

Fig. 2—8 shows the receive relay circuit. The relay K-101 is a polar type and, like all polar relays, contains a permanent magnet in addition to two or more coils. If only one coil is in use, the polarity of the current through that coil determines whether the armature (pin 6) operates to the Mark contact (pin 7) or to the Space contact (pin 4). If a second coil is also used, the polarity of its current with respect to the current in the first coil determines whether it shall aid or oppose the action of the first coil. Regardless of how the coils are connected, the magnitude and polarity of the resultant magnetic flux is due to the addition of the two currents. If the currents are equal and are so connected that they oppose each other, then they "add" and cause a magnetic flux of zero magnitude. As soon as the magnetic flux changes polarity even though of small magnitude, the armature (6) will operate to the other contact. If there is no magnetic flux the armature will stay on the last contact to which it was operated. The third winding, in this case, consists of only a few turns which are shorted at the relay socket to provide damping effects. This damping permits high speed keying without contact bounce.

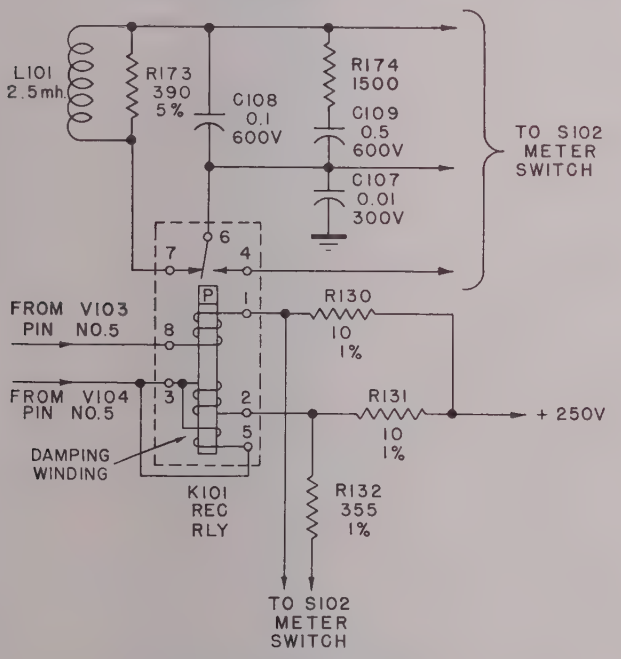


Figure 2—8. Receive Relay Circuit

This relay K-101 is connected in the receive relay circuit so that the plate currents of V-103 and V-104 have opposing effect. Therefore as soon as the plate current of V-103 exceeds that of V-104 the armature (6) of the relay operates to the Mark contact (7). Likewise, as soon as the plate current of V-104 exceeds that of V-103 the armature operates to the Space contact (4). L-101, R-173, C-108, C-109, R-174, and C-107 collectively form a spark-suppression and wave-shaping network. This network is needed to compensate for the inductive reaction peculiar to some models of teletypewriters. The output circuit of relay K-101, consisting of the armature (6) and the contact (7), connects through the metering switch S-102 to the external teletype loop. The other contact (4) only ties to the metering switch.

When measuring (REC BIAS) contacts (4) and (7) as well as the armature (6) are used for metering. The resistors R-130 and R-131 are used for measuring plate currents. The voltages developed across these resistors are proportional to the plate currents and are applied to the meter, through R-132 and the switch S-102, when the meter switch is in the PLATE CURR position. See Fig. 2—28.

7. TELETYPEWRITER DISTORTION.

A teletypewriter signal consists of groups of Mark and Space impulses. Each group is caused by the operation of one key or letter on a teletypewriter keyboard. The group formed by each letter always starts with a Space impulse, followed immediately by five selector impulses that may be either Mark or Space depending on the letter of the keyboard, and always terminates with a Mark impulse. All of these impulses with the exception of the final Mark impulse should be the same length. In the majority of cases the teletypewriters are geared to operate at 60 words per minute, known as "60 speed", and the above impulses are each 22 milliseconds long. The final Mark impulse is 42% longer than the others and, at 60 speed, is 31 milliseconds long. In various methods of communication involving teletypewriters the signals may be left in the form of current impulses in a series dc loop or the current impulses may be converted to a tone keyed on and off, to a radio carrier, or to two audio tones (one for Mark and one for Space). In every case the form of intelligence must finally be reconverted to a direct current arranged to operate a teletypewriter. The various methods of transposing intelligence from one form to another and back again usually introduce a distortion known as "bias". This distortion results in the Mark and Space impulses being elongated or shortened with respect to their normal length. The length of time for a teletypewriter letter is fixed by the mechanical gearing of the machine and cannot be altered or distorted. However, the individual Mark impulses can be lengthened, while simultaneously the Space impulses are shortened, or vice versa. If the Marking impulses are longer than normal, the condition is known as Marking Bias or conversely, if the Space impulses are too long the condition is known as Spacing Bias.

8. RECEIVE BIAS ADJUSTMENT.

A teletypewriter can operate with a considerable amount of bias in its signal. Exactly how much bias it can stand without misprinting is determined by many things such as adjustments of its mechanism or speed of its motor. To compensate for bias, a control marked REC BIAS is furnished on the Teletypewriter Terminal. The operation of this control, previously described in Section 2, par. 5, causes the plate currents of V-103 and V-104 to vary inversely. Fig. 2—9 shows the shape of the Mark and Space plate impulses when the incoming tones are evenly spaced

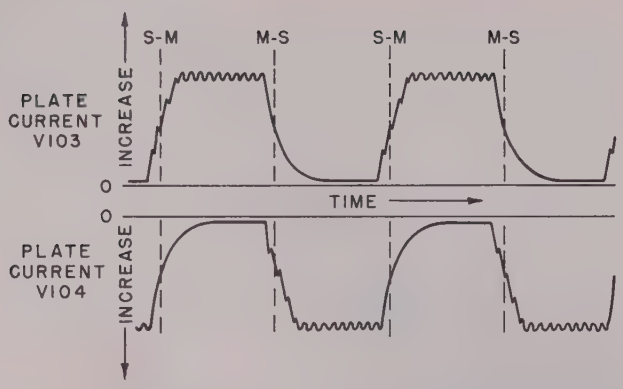


Figure 2—9. Unbiased Impulses

groups of 700 cps and 500 cps signals. For purpose of explanation, the Space impulses are shown upside down to indicate the opposing action of the two plate currents upon the resultant flux in the receive relay, as described in Section 2, par. 6. The ripples in the wave forms of Fig. 2—9 are due to the incoming signal and have no appreciable effect on the operation of the relay. It may be noticed that the ripples show that the Space tone starts as soon as the Mark tone ends and vice versa. The Space-to-Mark transition (S-M) closely follows the starting time of the Mark tone. Likewise, the Mark-to-Space transition (M-S) closely follows the starting time of the Space tone. These transitions take place immediately after the two plate currents are equal.

Fig. 2—10 shows the effect when one plate current (V-103) is increased and the other plate current (V-104) is decreased by the operation of the REC BIAS control. The ripples show that the timing of the incoming tones has not changed. The S-M and the M-S transitions still take place when the two currents are equal but it should be noted that the relative spacing on the time axis has now changed. As the length of time from the S-M to the M-S transition has now increased, the relay armature would be

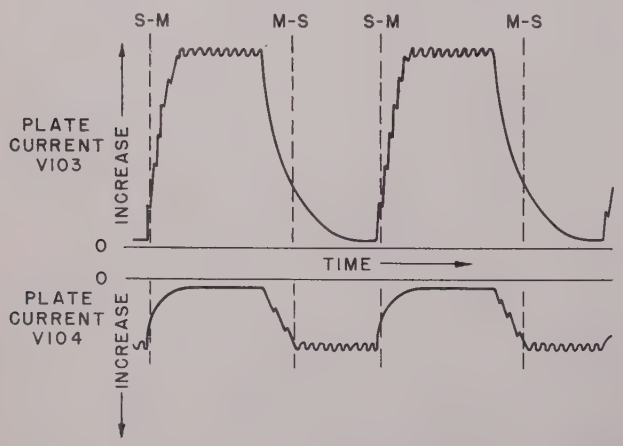


Figure 2—10. Biased Impulses

operated to and held against the Mark contact longer than normal and the dc signals to the teletypewriter would have Marking bias. It is evident that rotation of the REC BIAS control in the opposite direction would cause the above conditions to change conversely and the signals to the teletypewriter would have Spacing bias. Under actual conditions, it would be undesirable to deliberately introduce either Marking or Spacing bias, but the above explanations illustrate how the REC BIAS control can compensate for a bias distortion that may be introduced internally or externally. Where the timing of the tone groups is distorted or the amplitude of the rectified Mark and Space impulses is incorrect the REC BIAS control will usually permit sufficient compensation to correct the trouble.

9. SEND RELAY CIRCUIT.

The send relay K-102, which has three coils, is shown in Fig. 2—11. The current in the winding connected to the teletypewriter loop (pins 1 and 8) is 60 ma when the loop is in Mark condition and zero in Space condition. In standby condition this current is reduced to 36 ma. The current in the second winding (pins 2 and 3) is steady at about 30 ma but can be adjusted between 20 and 40 ma by the SEND BIAS control. This second winding is called a space winding.

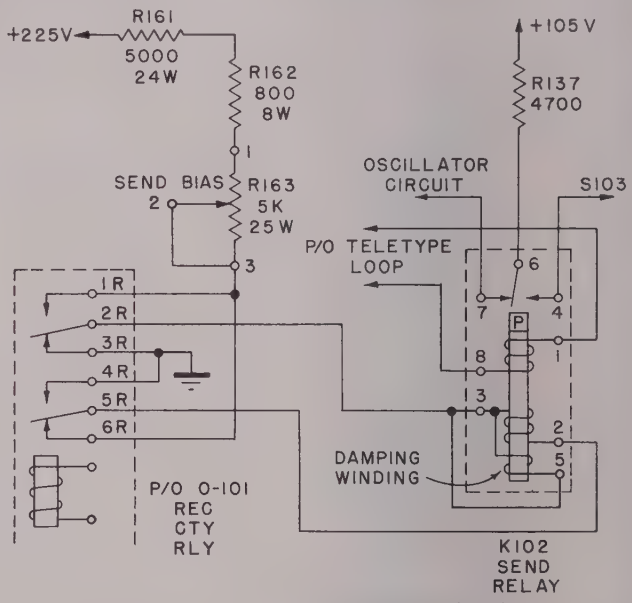


Figure 2—11. Send Relay Circuit

In standby condition, the 30 ma current flowing in the space winding produces a magnetic flux that is weaker and opposite to the flux produced by the 36 ma closed teletypewriter loop current flowing in the other winding of the send relay. The resultant flux holds the send relay armature against the Mark contact, pin 7. The third winding, in this case, consists of only a few turns which are shorted at the relay socket to provide damping effects. This damping permits high speed keying without contact bounce.

In sending, the above conditions are repeated for Mark only, with the exception that the closed loop current increases to 60 ma. For space, the teletypewriter loop current drops to zero and the unopposed flux produced by the

30 ma current draws the relay armature to the Space contact, pin 4. When a message is typed the loop current is rapidly and repeatedly changed from zero to 60 ma and back to zero again. The resultant flux is continually reversed and, consequently, the relay armature is continually switched from Mark (pin 7) to Space (pin 4) and back again.

In receive condition, the 30 ma current in the second winding is reversed by action of the receive control relay (REC CTL RLY), 0-101, thus reversing its flux so that it now aids the flux produced by the teletypewriter loop current. Therefore, regardless of the loop current, resultant flux in the send relay is always in the same direction, thus the relay armature is kept on the Mark contact. This interlock feature prevents the send relay from operating when receiving messages.

10. SEND BIAS ADJUSTMENT.

Under ideal conditions, the waveshape of the loop current impulses is square as shown in Fig. 2—12. But when the teletypewriter loop has more capacity because of a

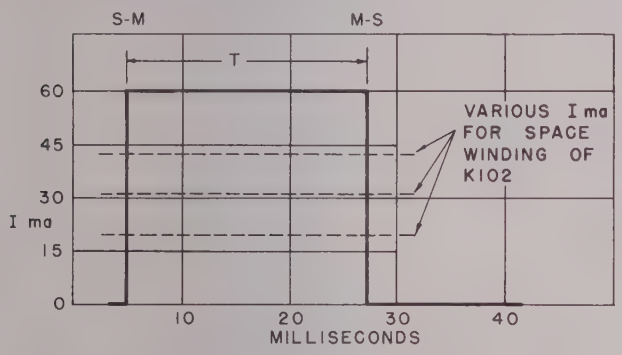


Figure 2—12. Ideal Loop Impulse Waveshape

long loop, or when it has more inductance because of several teletypewriters in the loop, the impulses become rounded as in Fig. 2—13 and lose the square shape. It should be understood that the important factor is not the actual change in waveshape but it is the change of impulse length which is the result of a change in waveshape. This

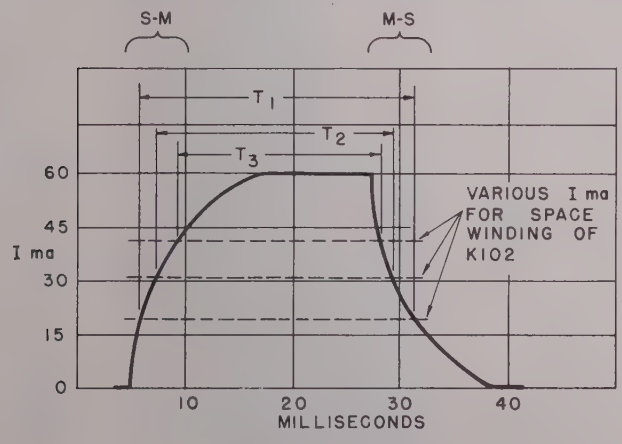


Figure 2—13. Biased Loop Impulse Waveshape

change of impulse length is teletypewriter distortion or bias and is discussed in Section 2, par. 7.

The SEND BIAS control is provided to correct for this change of impulse length. It is a rheostat that is connected in series with the space winding of the send relay K-102 shown in Fig. 2—11. It was explained in the previous paragraph that the space winding of the send relay K-102 has an adjustable but continual current flowing through it which, during transmit condition, produces a flux that opposes the flux produced by the loop current. For purposes of explanation, the space current is shown in the same direction as the loop current in the figures. Because of the opposing action of these currents, the transition of the relay armature takes place when one current exceeds the other current. Therefore, in Fig. 2—12, the transition point is where the impulse current shown by the heavy line crosses the space current shown by the dotted horizontal line. As the impulse is square, increasing or decreasing the space current by varying the SEND BIAS control has no affect upon the point of transition. The transition points are indicated on the figure by S-M and M-S. If neither of these transition points is changed, the time T between transitions remains the same.

When the waveshape is not square, as shown in Fig. 2—13, varying the space current by adjusting the SEND BIAS control causes the points of transition to change. Notice that when the space current is about 30 ma, the time T2 between transitions is normal. An increase of space current shortens the time to T3 while a decrease of space current increases the time to T1. Consequently, the time T between transitions can be varied by the SEND BIAS control to correct for teletypewriter distortion.

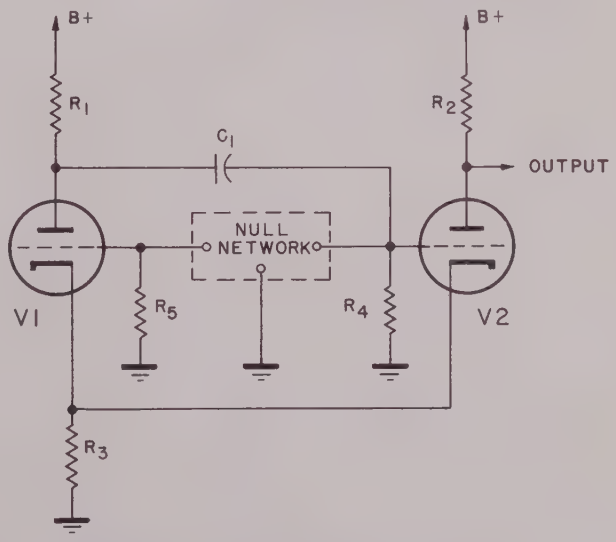


Figure 2—14. Basic Audio Oscillator

If it is necessary to adjust the SEND BIAS control to its extreme counter-clockwise position to fully compensate for Marking bias, it will be necessary to correct the bias condition in the teletypewriter loop. If more than 36

ma flows in the space winding of the send relay the equipment cannot remain stable in standby condition.

11. BASIC AUDIO OSCILLATOR.

The basic audio oscillator circuit is shown in Fig. 2—14. Triodes V-1 and V-2 are connected so that, disregarding the null network for the moment, they form a free-running multivibrator. Variations in plate current of V-1 produce voltages across R-1 that are fed through C-1 to the grid of V-2. Then V-2 reacts to these signal voltages and produces signal voltages across the common cathode resistor R-3. Thus, the original signal from the plate of V-1 returns in phase to the cathode of V-1 and therefore the two tubes oscillate. A more detailed explanation of this multivibrator is covered in radio-technician training

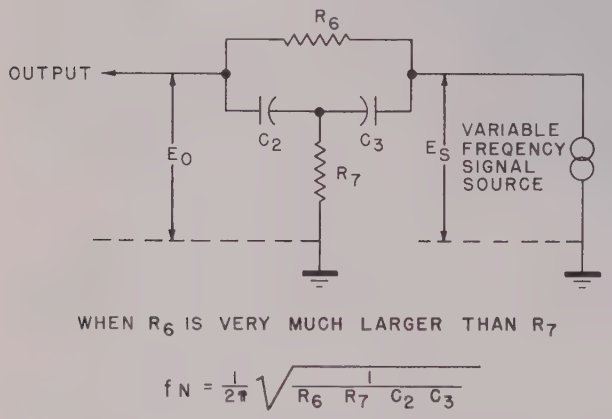


Figure 2—15. Basic Null Network

courses. Most important is the fact that this type of multivibrator is easy to synchronize so that it holds to a given frequency but is very unstable without synchronization.

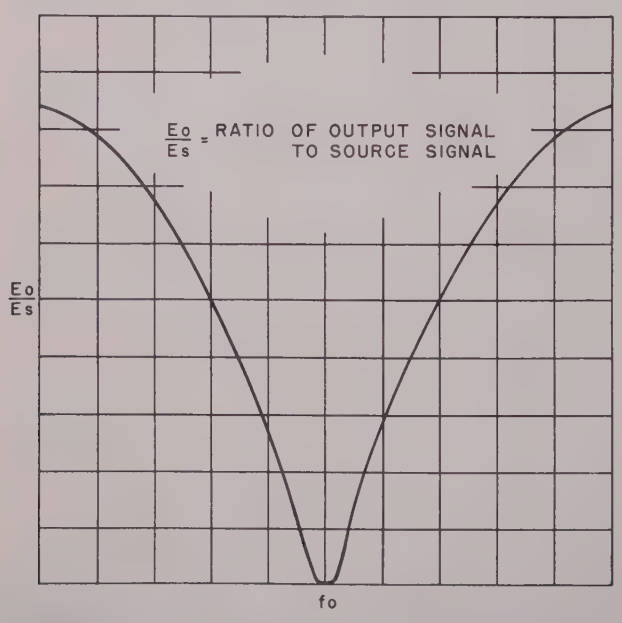


Figure 2—16. Characteristic of Null Network

The basic null network is a bridged-T type and is shown in Fig. 2—15. Resistor R-6 must be very much larger than R-7 for the network to operate satisfactorily. The nature of this circuit is such that all frequencies but one, that may be applied to one end of the network, will appear at the other end. The reason that the one frequency (the null frequency) does not appear at the other end of the network is that it is cancelled because of phase and magnitude relationships as it passes through the T-network and the bridging resistor. See curve, Fig. 2—16. Referring again to Fig. 2—14 it may be seen that all frequencies, except the null frequency, that are coupled to V-2 from V-1 are reapplied not only to the cathode but also through the null network to the grid of V-1. Any frequency that is applied to both the grid and cathode does not appear on the plate because the grid-to-cathode voltage does not change. But, since the null frequency cannot pass through the null

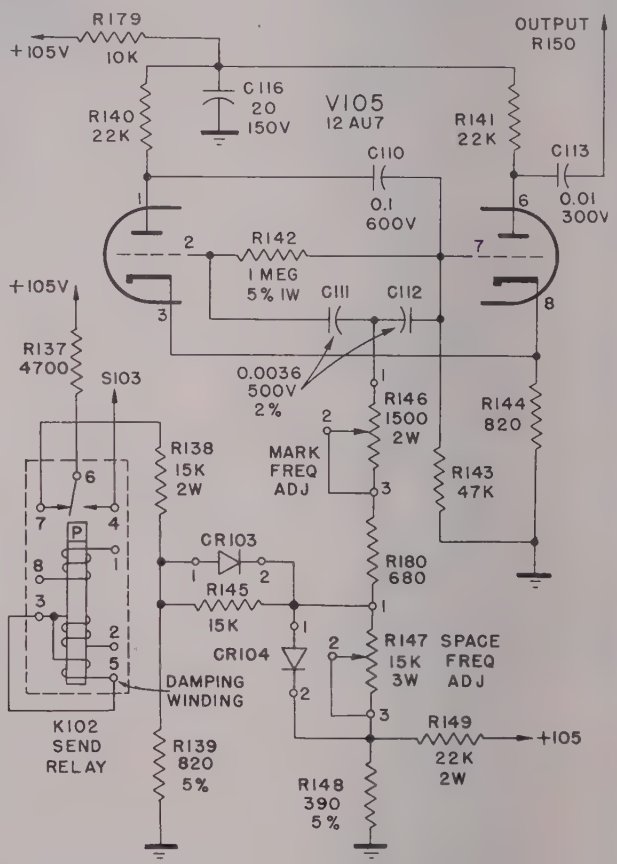


Figure 2—17. Two-Tone Oscillator

network to the grid, it only appears on the cathode where it changes the grid-to-cathode voltage and causes V-1 to again produce the null frequency on its plate. Therefore the multivibrator can oscillate at only the null frequency. It can be seen by the formula in Fig. 2—15 that a decrease in the resistance of R-7 would cause the null frequency to shift higher and an increase in the resistance of R-7 would cause the null frequency to shift lower.

12. TWO-TONE OSCILLATOR.

In Fig. 2—17 is the circuit of the multivibrator, or two-tone oscillator that is actually used in the Teletypewriter Terminal. The null network is composed of C-111, C-112, R-142 with the resistors R-146, R-180, R-147 and R-148 replacing R-7 of the basic null network. The grid leak resistor R-143 and the coupling capacitor C-110 have only a negligible effect on oscillator frequency. Distortion in the sine wave output is removed by the band-pass filter to be discussed later.

With resistors R-146, R-180, R-147, and R-148 in series with the null network, the resistance is a maximum so the oscillator oscillates at the lowest frequency of 500 cps or Space tone frequency. To increase the frequency to 700 cps, the Mark tone frequency, the resistance must be decreased. This is accomplished by shorting out R-147. With only R-146, R-180, and R-148 in the circuit, the frequency of the Mark tone may be adjusted by varying the resistance of R-146. Varying the resistance of R-147, when it is in the circuit, adjusts the Space tone frequency. The point that must be understood and remembered here is that when R-146 and R-147 are properly adjusted, shorting out R-147 causes a change from Space tone (500 cps) to Mark tone (700 cps).

Referring to Fig. 2—18, a current flowing from ground through R-148 and R-149 to the positive 105 V supply develops about plus two volts at the top end of R-148.

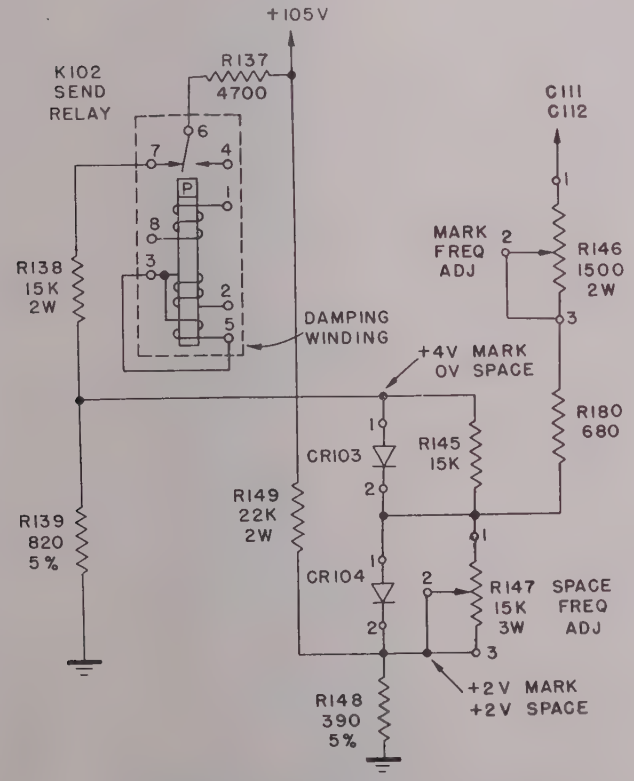


Figure 2—18. Oscillator Frequency Changing Circuit

Therefore the bottom end of the germanium diode, CR-104 is plus two volts with respect to ground. When the send relay is in Mark position (pin 7), another current flows from ground through R-139, R-138, the send relay contacts, and R-137 to the positive 105 V supply. This current develops about plus four volts at the top end of R-139 so the top end of the germanium diode, CR-103 is about plus four volts with respect to ground. If the send relay armature moves to the space contacts (pin 4), the above current drops to zero. Then the top end of CR-103 is zero instead of plus four volts with respect to ground. The voltages corresponding to Mark and Space condition have been noted on Fig. 2—18 at the points where those voltages appear.

Now the function of the two diodes and resistors, R-145 and R-147 may be analyzed. The resistance a germanium diode offers to a current depends upon the polarity of the current. Since it was found that for Space condition the voltage is zero at the top end and plus two volts at the bottom end of the diodes, a current attempting to flow

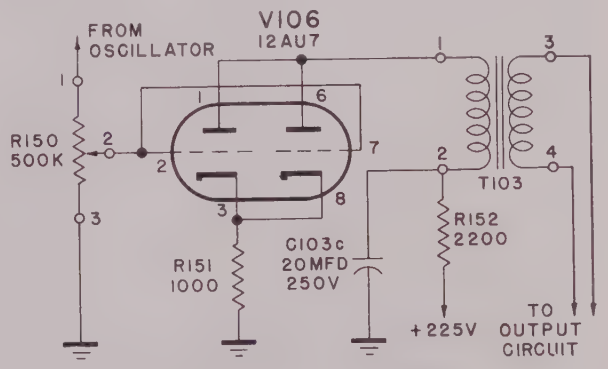


Figure 2—19. Tone Amplifier

through the diodes in this backward direction encounters high resistance. And, since it was found that for Mark condition the voltage is plus four volts at the top end and plus two volts at the bottom end of the diodes, a current attempting to flow through the diodes in the forward direction encounters very little resistance. The effect when in Mark condition with the current flowing in the forward direction is essentially as if R-147 were shorted. On the other hand, in Space condition the effect is essentially as if the diode CR-104 was not connected in parallel with the resistor R-147. Thus the send relay causes the oscillator frequency to shift back and forth between Mark and Space frequencies due to the diodes CR-103 and CR-104 "opening" and "shorting".

13. TONE AMPLIFIER.

Mark and Space tones from the oscillator are fed to the tone amplifier shown in Fig. 2—19. This amplifier is a single stage twin triode amplifier with the two triodes parallel connected to provide low plate resistance. The input level of the tones is adjustable by means of the SEND LEVEL potentiometer R-150 in the grid circuit. Resistor R-152 and capacitor C-103c decouple this stage

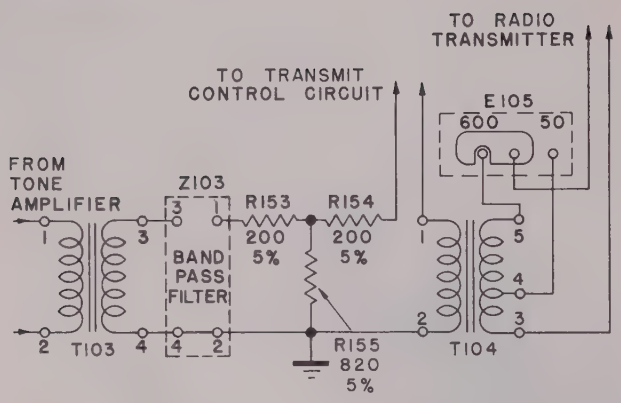


Figure 2—20. Output Circuit

from the plate supply voltage. Degeneration, due to the unbypassed cathode resistor, maintains the two tone frequencies at approximately the same relative level. The amplified tones are transferred to the output circuit through the plate transformer T-103.

14. OUTPUT CIRCUIT.

Transformer T-103 introduces the signal into the output circuit. This circuit, Fig. 2—20, is composed of a band-pass filter, a 6 db pad, and an isolation and impedance matching transformer. As stated previously, the output signal of the oscillator contains distortion. This distortion, due to some harmonic content in the signal, is greatly reduced by the band-pass filter. Frequencies from 400 to 800 cps pass through the filter with only about 2 db attenuation while other frequencies including harmonic frequencies are greatly attenuated. This 6 db pad is identical to the input 6 db pad and fulfills the same purpose. It minimizes the effects of a possible mismatch between the Terminal and the radio transmitter.

Before the signal can reach the impedance matching transformer T-104, it must pass through a set of contacts on the transmit control relay. These contacts are closed when a message is to be transmitted. The secondary of T-104 is tapped so that it may be matched to 600 ohms or 50 ohms. A link which may be changed from the 600 ohm terminal to the 50 ohm terminal is provided on the Teletypewriter Terminal chassis. The 50 ohm winding of the transformer is of larger wire that can carry dc current when the Teletypewriter Terminal is connected to the carbon microphone circuits of the radio transmitter.

15. RECEIVE CONTROL RELAY CIRCUIT.

The receive control relay circuit is shown in Fig. 2—21.

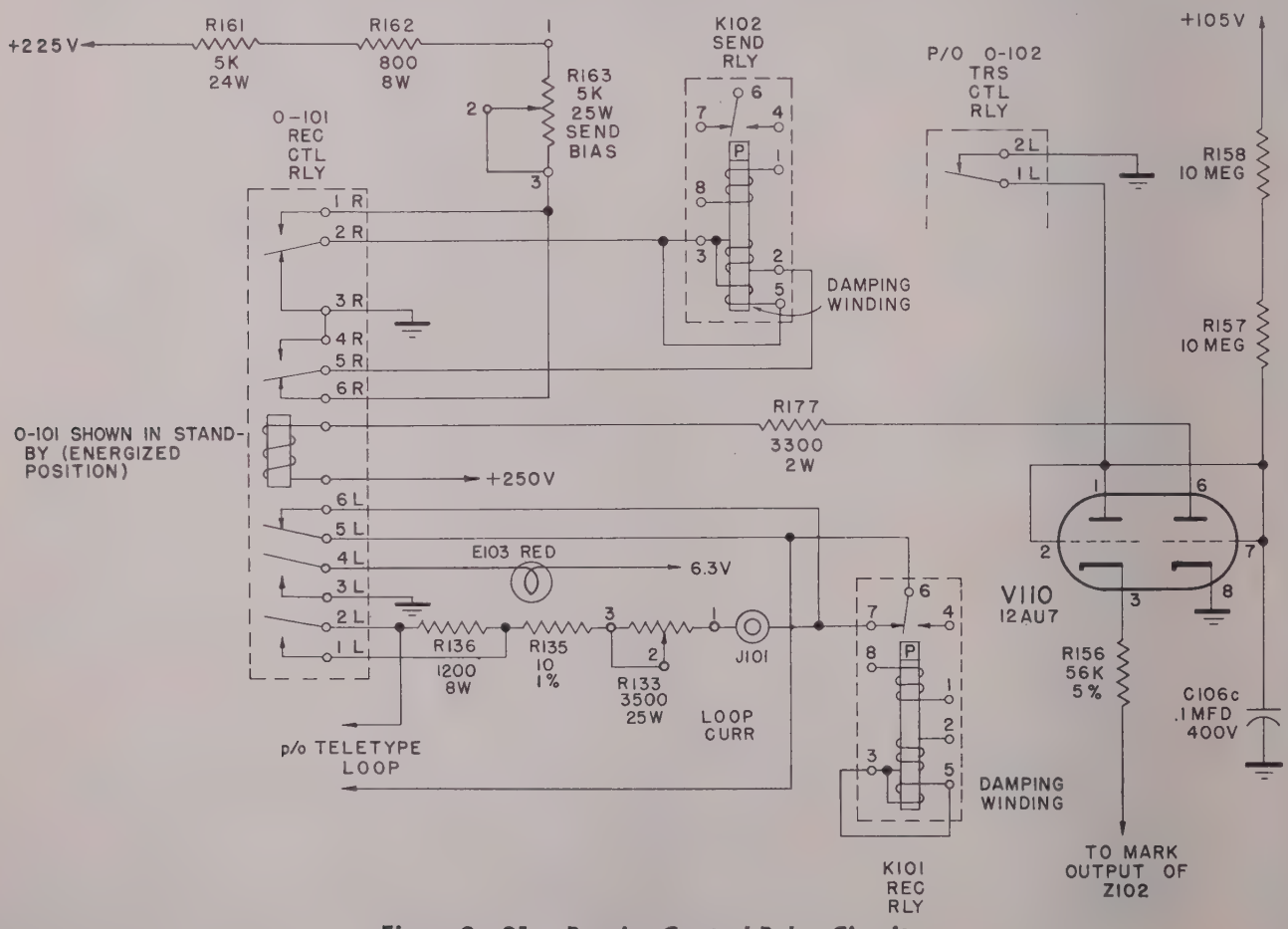


Figure 2—21. Receive Control Relay Circuit

A twin triode V-110 with one triode connected as a diode, operates the REC CTL RLY so that the various relay contacts open and close other circuits. One end of the REC CTL RLY winding is connected to the 250 V supply and the other end is connected through a resistor R-177 to the plate (6) of the triode. The relay is energized when plate current flows. Plate current flow is controlled by the bias voltage on the grid (7). The grid bias is determined by two factors; the condition of the transmit control relay and the presence of incoming signals.

In standby condition, the transmit control relay contacts, connected to the grid of the triode, are open. Also, no signal voltages are applied to the diode from the receive circuit. Under these conditions, the grid is slightly positive because the capacitor C-106c is charged positive from the positive 105 V supply. Grid current through R-157 and R-158 limit this grid voltage to about plus one volt. The lack of negative bias causes plate current to flow during standby condition and the REC CTL RLY is energized. The resistor R-177 limits the plate current to a safe value.

Now if the receive circuit begins to receive signals, the Mark frequency is applied to the cathode (3) of the diode through R-156 and when the cathode swings negative during half of each audio cycle the diode rectifies. The diode, the 56,000 ohm resistor R-156, and the capacitor C-106c, form a series circuit having a time-constant much less than the time-constant of the series circuit composed of the two ten-megohm resistors, R-158, R-157, and the capacitor C-106c. Consequently, the higher current in the lower time-constant diode circuit determines the polarity of the charge on C-106c. Since the diode rectifies on negative half-cycles, it charges C-106c negative thus biasing the triode section to cut-off and thereby de-energizing the relay during receive condition. A short time after the last Mark tone is received the capacitor C-106c discharges toward positive and the REC CTL RLY is again energized.

When in transmit condition, the transmit control relay (0-102) shorts the grid to ground-potential so that the grid and cathode of the triode V-110 are at the same potential which results in plate current flowing. So, in transmit condition the REC CTL RLY is energized. Since the TRS CTL RLY keeps both ends of C-106c at ground-potential, an incoming signal cannot charge C-106c and therefore cannot cause the REC CTL RLY to release to the receive condition. This interlock feature of the Teletypewriter Terminal prevents the Terminal from changing directly from transmit condition to receive condition without first being released to standby condition. In brief, the REC CTL RLY is always energized except when the Terminal is in receive condition.

To examine the functions of the REC CTL RLY contacts, refer to Fig. 2—21. The two sets of SPDT contacts at the top of the figure (1R, 2R, 3R, 4R, 5R, and 6R) control the direction of the current flowing through the send relay space coil. Reversing this current, when in receive condition, prevents the send relay from functioning, as explained in Section 2, par. 9. Contacts 5L and 6L shown immediately below the REC CTL RLY coil close during transmit and standby conditions (as shown), thus shorting pins 6 and 7 of the receive relay so that the teletypewriter loop is closed at this point. Contacts 3L and 4L only apply voltage to the receive indicator light (E-103) when in receive condition. Contacts 1L and 2L short out resistor R-136 that is in the teletypewriter loop. When this resistor is shorted out during receive condition, the loop current rises from 36 ma to 60 ma. When a teletypewriter is intalled elsewhere than within visible range of the indicator lights of the Teletypewriter Terminal, a 100 ma meter may be inserted in series with the teletypewriter loop. When the meter is steady and reads about 36 ma, the Terminal is in standby condition. This is due to the 1200 ohm resistor R-136 adding to the normal resistance of the loop and decreasing the current. When the Terminal is in receive or transmit condition, the resistor R-136 is shorted out and the loop carries 60 ma except during keying. Consequently the inserted meter reads 60 ma or fluctuates rapidly indicating keying.

16. TRANSMIT CONTROL RELAY CIRCUIT.

The transmit control relay circuit is shown in Fig. 2—22. A twin triode V-111 with one triode connected as a diode, operates the TRS CTL RLY so that the various relay contacts open and close other circuits. One end of the TRS CTL RLY winding is connected to the 250 V supply and the other end is connected through a resistor R-178 to the plate (1) of the triode. The relay is energized when plate current flows. Plate current flow is controlled by the bias voltage on the grid (2). The grid bias is determined by two factors; the position of the control switch S-103 and the position of the send relay (K-102) armature (6). The cathode of the diode section is connected through a resistor R-160 to the output of the audio oscillator. It should be understood that the audio oscillator is always oscillating at either the Mark or Space frequency. Therefore, an ac voltage is always applied to the diode cathode. When the control switch is in position for automatic (AUTO) operation, as shown in the figure, it connects the Space contact pin 4 of the send relay, to the plate of the diode through resistor R-176. With the control switch on AUTO, an incoming signal causes the Terminal to change from standby to receive condition or keying the local teletypewriter causes the Terminal to change from standby to transmit condition.

In standby and receive condition, the send relay holds the send relay armature on Mark contact (7) so Space contact (4) is open. Thus the only voltage applied to the diode section of tube V-111 is the oscillator ac voltage. On negative half-cycles, the diode rectifies this ac voltage and charges capacitor C-114 negative. This negative voltage on the capacitor is applied through resistor R-159 to the triode grid. Thus the negative grid prevents the flow of plate current so the TRS CTL RLY is not energized during standby and receive condition.

When a message is being typed locally, the armature of the send relay intermittently applies positive 105 V to space contact (4). This voltage is applied through R-176

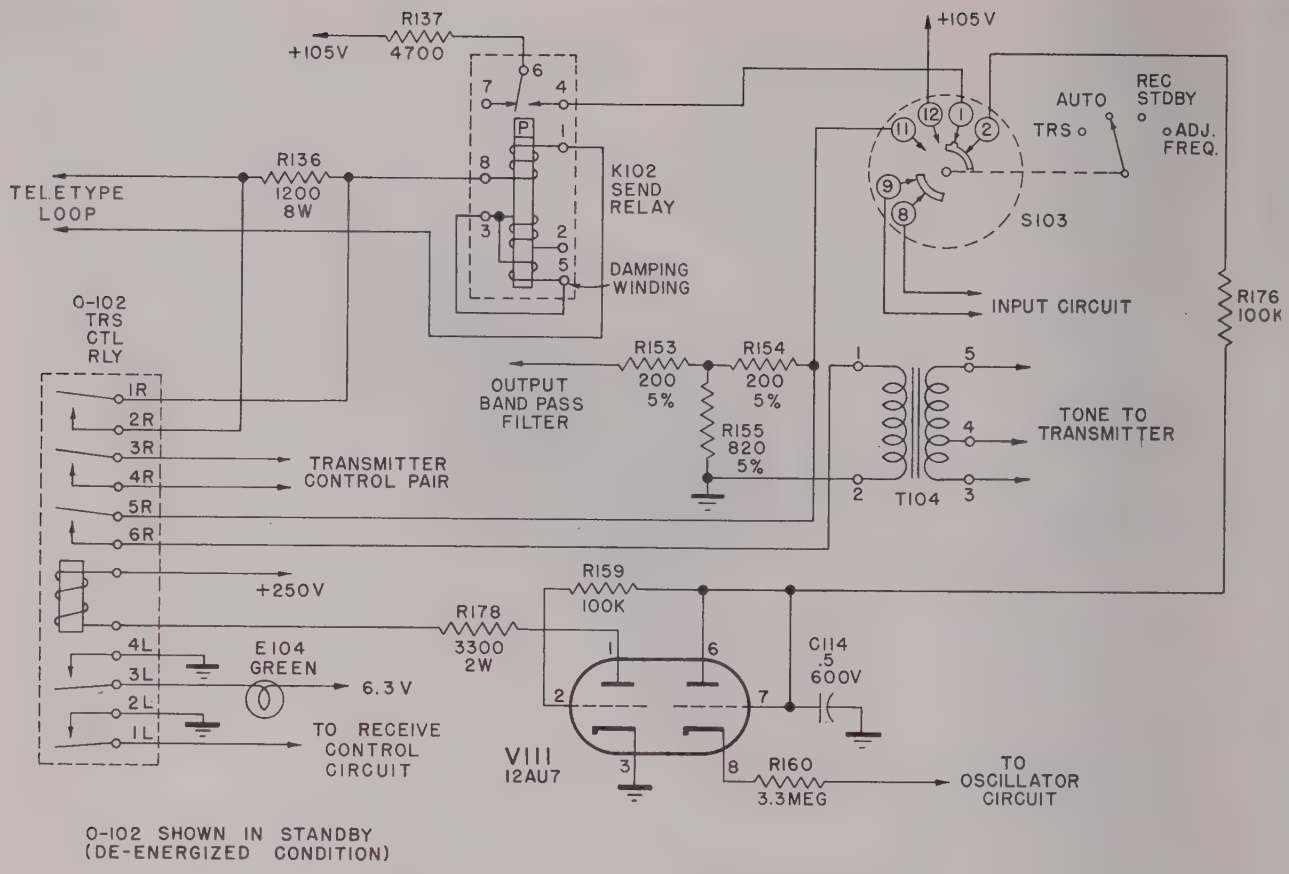


Figure 2—22. Transmit Control Relay Circuit

to the capacitor C-114. R-176 and C-114 have a lower time-constant than R-160 and C-114 so C-114 is charged positive by the 105 V supply. This positive voltage on the capacitor causes diode current through R-176 which limits the voltage to about plus one volt. This voltage is applied through R-159 to the triode grid causing plate current to flow. The resistor R-178 limits the plate current to a safe value. Thus, the TRS CTL RLY is energized during transmit condition. Capacitor C-114 requires approximately three seconds to discharge when there are no outgoing signals. Therefore, there is a time delay of approximately three seconds before the transmit control circuit can change to standby condition. This time delay feature holds the Terminal in transmit condition despite short breaks in the outgoing message.

When the control switch S-103 is turned to the receive position, the diode section of V-111 is disconnected from Space contact (4) so that the send relay cannot cause the TRS CTL RLY to shift to transmit condition. When the control switch is turned to the transmit position the 105 V supply is directly connected to the diode section of V-111 so that the TRS CTL RLY must remain in transmit condition. In brief, the TRS CTL RLY is not energized except when in transmit condition.

To examine the functions of the TRS CTL RLY contacts, again refer to Fig. 2—22. Contacts 3L and 4L, shown at the bottom of the figure, simply apply power to the transmit indicator light E-104 during transmit condition. Contacts 1L and 2L ground the grid of the twin triode that operates the REC CTL RLY. This action prevents operation of the REC CTL RLY during transmit condition as described in Section 2, par. 15. Contacts 5R and 6R shown immediately above the relay coil close the output circuit during transmit condition so that the outgoing tones may reach the radio transmitter. Contacts 3R and 4R close the control line to the transmitter during transmit condition placing the radio transmitter "on the air". Contacts 1R and 2R short out resistor R-136 in the teletypewriter loop. When this resistor is shorted out during transmit condition, the loop current rises from 36 ma to 60 ma.

17. METERING CIRCUITS.

For purposes of explanation, the metering circuits have been broken down so that each position of the meter switch is shown in a separate figure. The short heavy lines with arrows represent the switching members. The first number near each junction refers to the deck number that the contact is on while the second number refers to the contact number on that deck.

Position 1, SEND BIAS, is shown in figure 2—23. In this switch position, the send bias control may be adjusted so that the meter reads zero on its upper scale indicating

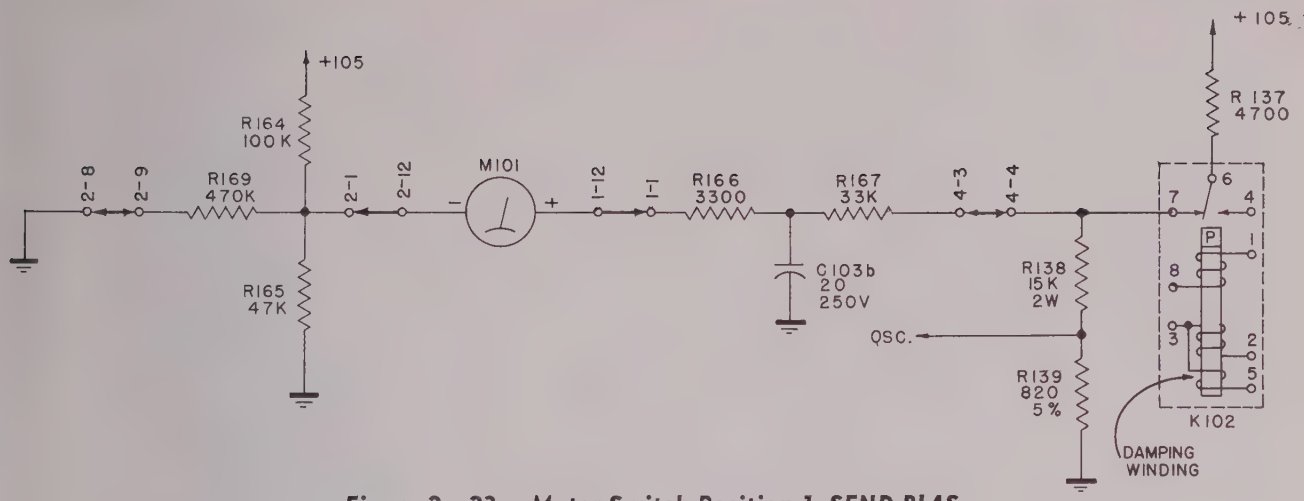


Figure 2—23. Meter Switch Position 1, SEND BIAS

proper length of Mark and Space tones that are being transmitted. See Section 2, par. 10 for a detailed analysis of the function of the send bias control. Switch contacts parallel resistor R-169 with resistor R-165 so that the voltage divider, composed of resistors R-169, R-165, and R-164, has the proper voltage divider ratio. This voltage divider applies a constant positive voltage to the negative side of the meter. The positive side of the meter is connected to the upper scale.

Position 2, SEND LEVEL, is shown in Fig. 2—24. In this switch position, the send level potentiometer, at the input to the tone amplifier, may be adjusted so that the meter (lower scale) indicates the proper level of the signals being fed to the transmitter. The switch contacts indicated in the figure connect the meter to a copper oxide rectifier, CR-105, and also connect the rectifier through

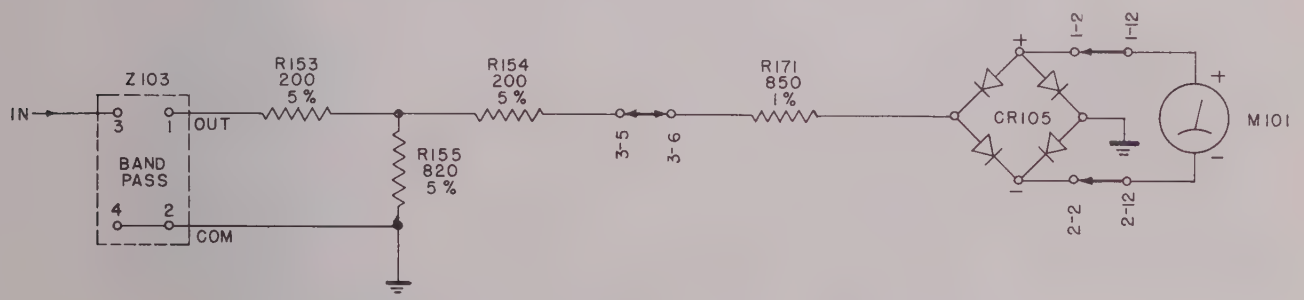


Figure 2—24. Meter Switch Position 2, SEND LEVEL

nected to a current limiting resistor R-166 and a filter section, R-167 and C-103b. This filter section is connected to Mark contact pin 7 on the send relay K-102. When the space bar is held down on the teletypewriter, the send relay armature moves back and forth between Mark and Space contacts. On Mark contact (7), the relay armature applies a positive voltage to the metering circuit. On Space contact (4), the positive voltage is not applied to the metering circuit so capacitor C-103b begins to discharge. Because of the actual fast movement of the send relay armature, the voltage on C-103b stabilizes at a value that is dependent upon the relative length of the Mark and Space impulses. If the Space impulse is too long, the voltage on C-103b has more time to leak off so that this voltage is low and if the space impulse is too short, the voltage is too high. The result is that when the Mark and Space impulses are of proper relative length the voltage on both sides of the meter are the same so it reads zero on

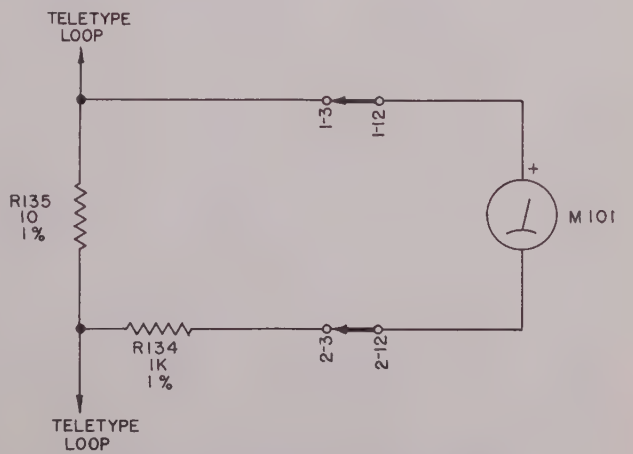


Figure 2—25. Meter Switch Position 3, LOOP CURR

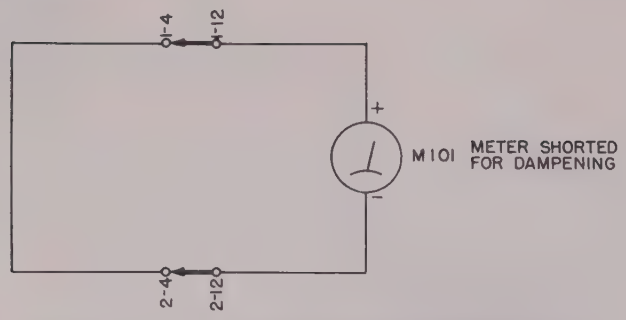


Figure 2—26. Meter Switch Position 4, OFF

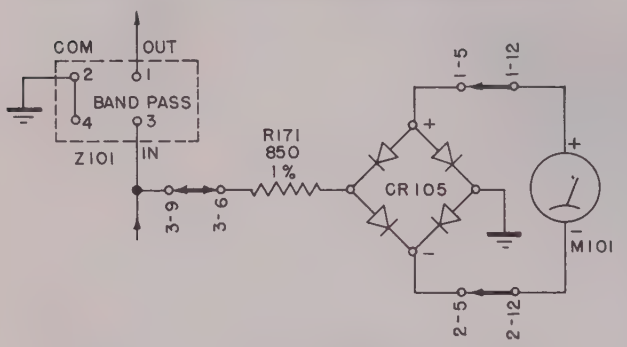


Figure 2—27. Meter Switch Position 5, REC LEVEL

R-171 to the output of the 6 db pad. Thus signals from the output of the band-pass filter Z-103 pass through the 6 db pad to the meter calibration resistor R-171 and rectifier. The full wave bridge rectifier CR-105 converts the signal to direct current and applies the current to the meter.

In Fig. 2—25 is shown switch position 3, LOOP CURR, for metering and adjusting loop current. The switch contacts connect the meter and a calibration resistor R-134 across a teletypewriter loop series resistor R-135. A voltage proportional to the current flowing in the loop is developed across R-135. The loop current rheostat may now be adjusted so that the meter reads 60 on the upper scale when the Terminal is in transmit condition. The meter

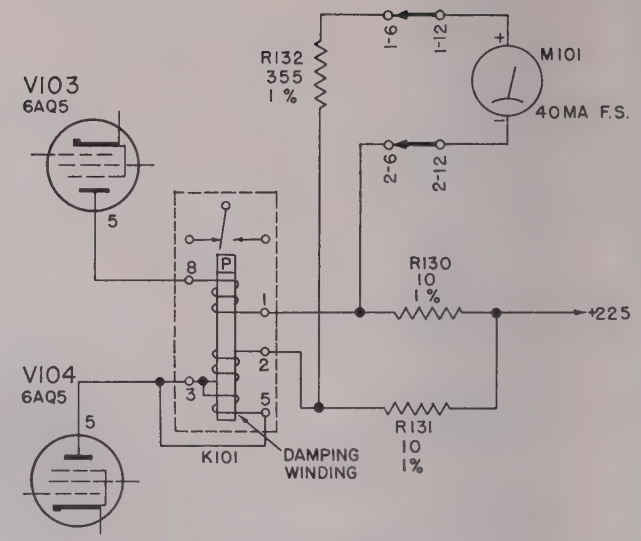


Figure 2—28. Meter Switch Position 6, PLATE CURR

should read to the right indicating correct polarity of current in the teletypewriter loop.

In position 4, OFF, switch contacts short the meter terminals together, Fig. 2—26. If vibration causes the meter pointer to move, the meter coil develops a back voltage that dampens its movement.

Position 5, REC LEVEL, is shown in Fig. 2—27. The function of this circuit and the send level meter circuit, position 2, previously described are very similar. Contacts indicated in the figure connect the meter to the same copper oxide rectifier CR-105, but in this case the contacts connect the rectifier to the input of the receive band-pass filter. Signals to the band-pass filter also pass through the meter calibration resistor R-171 to the full wave bridge rectifier and direct current, proportional to the signal, is applied to the meter from the rectifier. In this switch position the REC LEVEL attenuator in the receive circuit may be adjusted until the meter reads 0-dbm (lower scale).

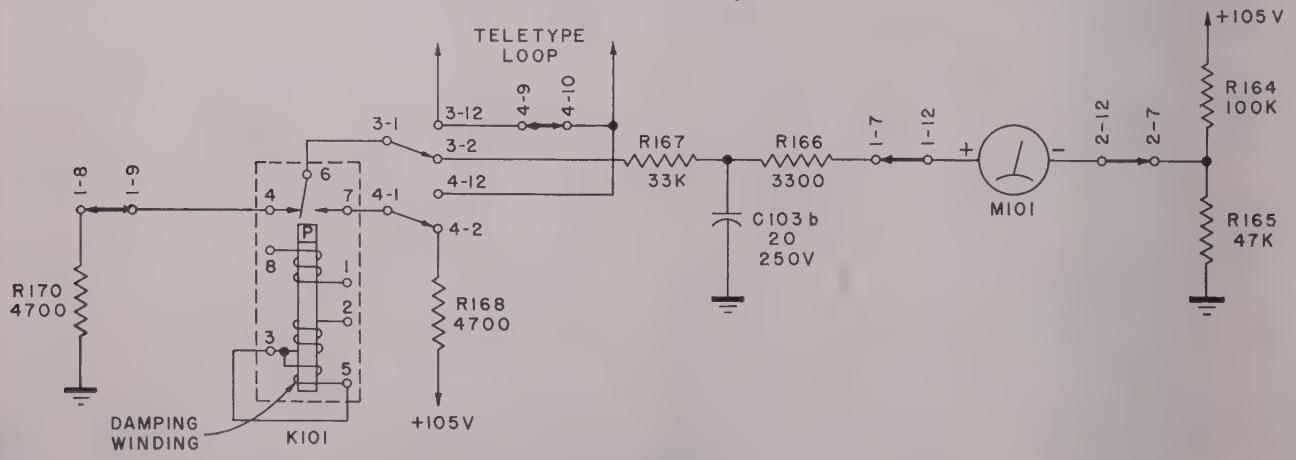


Figure 2—29. Meter Switch Position 7, REC BIAS

Position 6, PLATE CURR, is shown in Fig. 2—28. The switch contacts connect the meter and a calibration resistor R-132 across the plate sides of the dc amplifier metering resistors R-130 and R-131. The voltage that is applied to the meter is the difference of the two metering resistor voltage drops that are developed across the resistors by the plate currents. Therefore, in effect, the meter reads the differential plate current. If a Mark and Space signal were present at the same time, the differential plate current would be zero so the meter would read zero. However, since only one signal is present at one time, only one tube conducts signal current so the differential current for Mark signal causes the meter to read to the right, for Space signal to the left. The current reading of the meter is only the current that is effective in producing resultant magnetic flux in the receive relay.

Position 7, REC BIAS, is shown in Fig. 2—29. In this switch position the receive bias control may be adjusted so that the meter reads zero on the upper scale indicating proper length of received Mark and Space impulses. See Section 2, par. 5 for a detailed analysis of the function of the receive bias control. The circuit for this switch position is the same as for position 1 previously described in this paragraph except that no resistor is connected in parallel with the voltage divider (R-164 and R-165) and the metering circuit is connected to the receive relay (K-101) armature (6) instead of the send relay contact. Also the operation is the same, in that when the Mark and Space impulses at K-101 are of proper length the voltages on each side of the meter are the same and the meter reads zero on the upper scale.

18. CONTROL SWITCH CIRCUIT.

As stated previously, the functioning of the Teletypewriter Terminal is determined by the position of the control switch. The control switch circuit is shown in Fig. 2—30 with the switch in ADJ FREQ position. In transmit (TRS) position, contacts 8, 9, 11 and 1 are open. Only contacts 12 and 2 are connected together so that the 105 V supply is connected to the diode section of the twin triode V-111 in the transmit control circuit. As explained in Section 2, par. 16, when this 105 V supply is applied to the transmit control tube, the TRS CTL RLY is energized for transmit condition.

In AUTO position, contacts 8 and 9 connect the radio receiver to the Terminal so that incoming signals may enter the Terminal input. Contacts 1 and 2 connect the transmit control circuit to the send relay so that the Terminal may assume standby, transmit, or receive condition as necessary and as explained in Section 2, par. 16.

In REC STDBY position, contacts 8 and 9 are connected together so that incoming signals may enter the Terminal and all other contacts are open therefore preventing the Terminal from going to transmit condition.

The fourth position is ADJ FREQ. All contacts are open except 9 and 11 which connect the output circuit of the Terminal to the input of the Terminal so that the Mark and Space tones produced by the audio oscillator are fed into the receive circuit. The receive circuit separates the Mark and Space tones and applies the rectified signal to the dc amplifier. When each tone is at the correct frequency, it receives a minimum of attenuation in

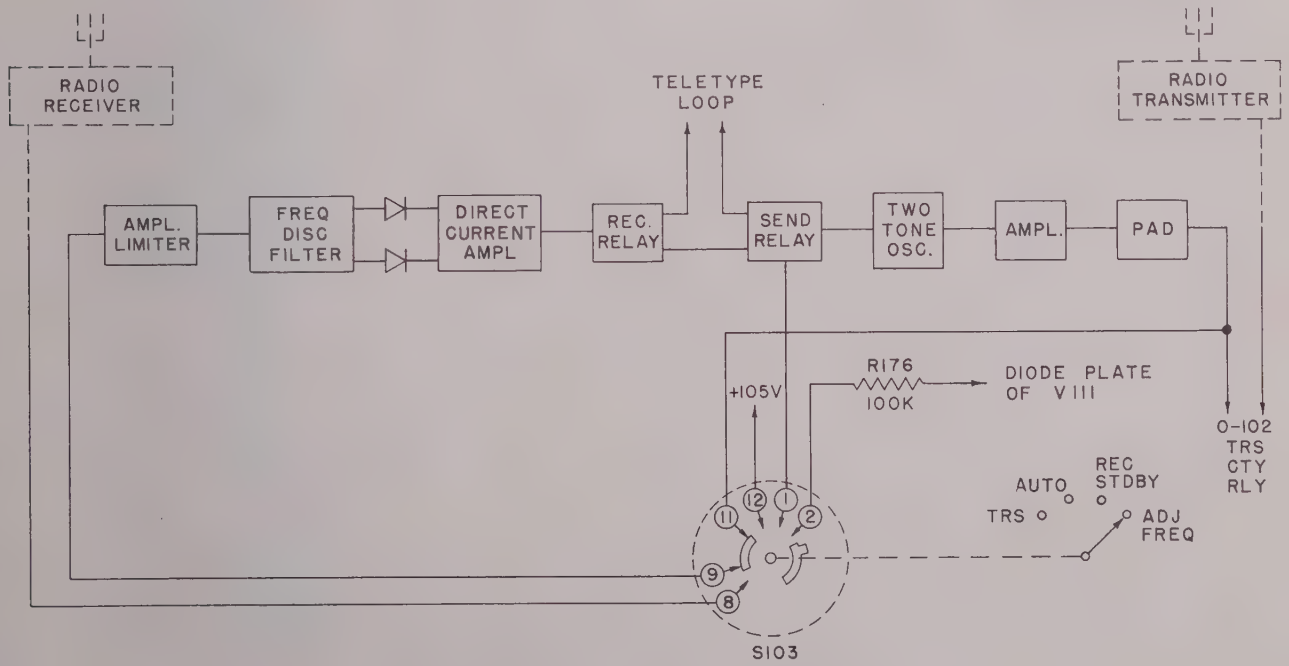


Figure 2—30. Control Switch Circuit

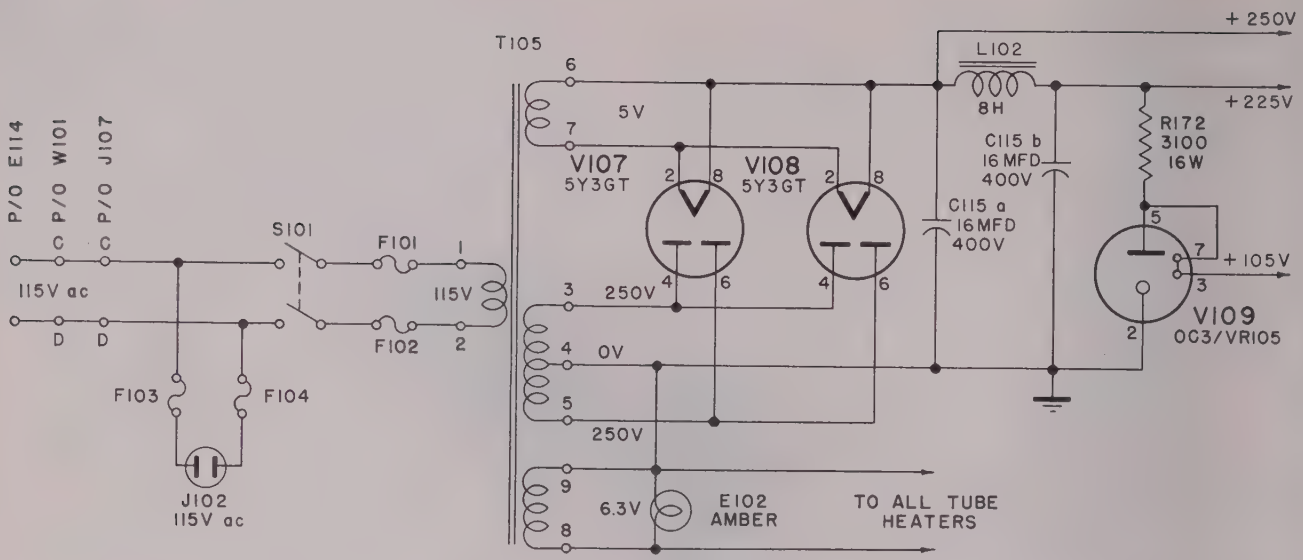


Figure 2—31. Power Supply

passing through the frequency discriminator filter so that when the signal is rectified it produces a maximum of voltage. A maximum voltage applied to the dc amplifier produces a maximum of plate current. Consequently, in Mark condition the MARK FREQ ADJ potentiometer may be varied until the plate current meter reads maximum to the right. In Space condition, the SPACE FREQ ADJ potentiometer may be varied until the meter reads maximum to the left.

To actually make these frequency adjustments, rotate the meter switch to the PLATE CURR position and rotate the control switch to the ADJ FREQ position. Since the teletypewriter loop is closed, the Terminal will be in Mark condition and the MARK FREQ ADJ potentiometer may be adjusted. To adjust the Space frequency, it is necessary to open the loop to simulate a Space. However, because of the interlocking features of the control circuits previously explained, even an open loop will not cause the Terminal to assume Space condition. Therefore it is also necessary to rotate the control switch to AUTO to release the interlocks so that the Terminal may assume Space condition. Then rotate the control switch back to ADJ FREQ so that Space tones are fed into the receive circuit. Then the SPACE FREQ ADJ potentiometer may be adjusted.

19. POWER SUPPLY.

The power supply circuit, shown in Fig. 2—31, is a conventional full-wave rectifier with two rectifier tubes connected in parallel for longer tube-life. The voltage regulator tube V-109 regulates the 105 V supply. The internal jumper of V-109 is connected in series with the 105 V supply to prevent possible damage to the equipment if the tube is removed from its socket.

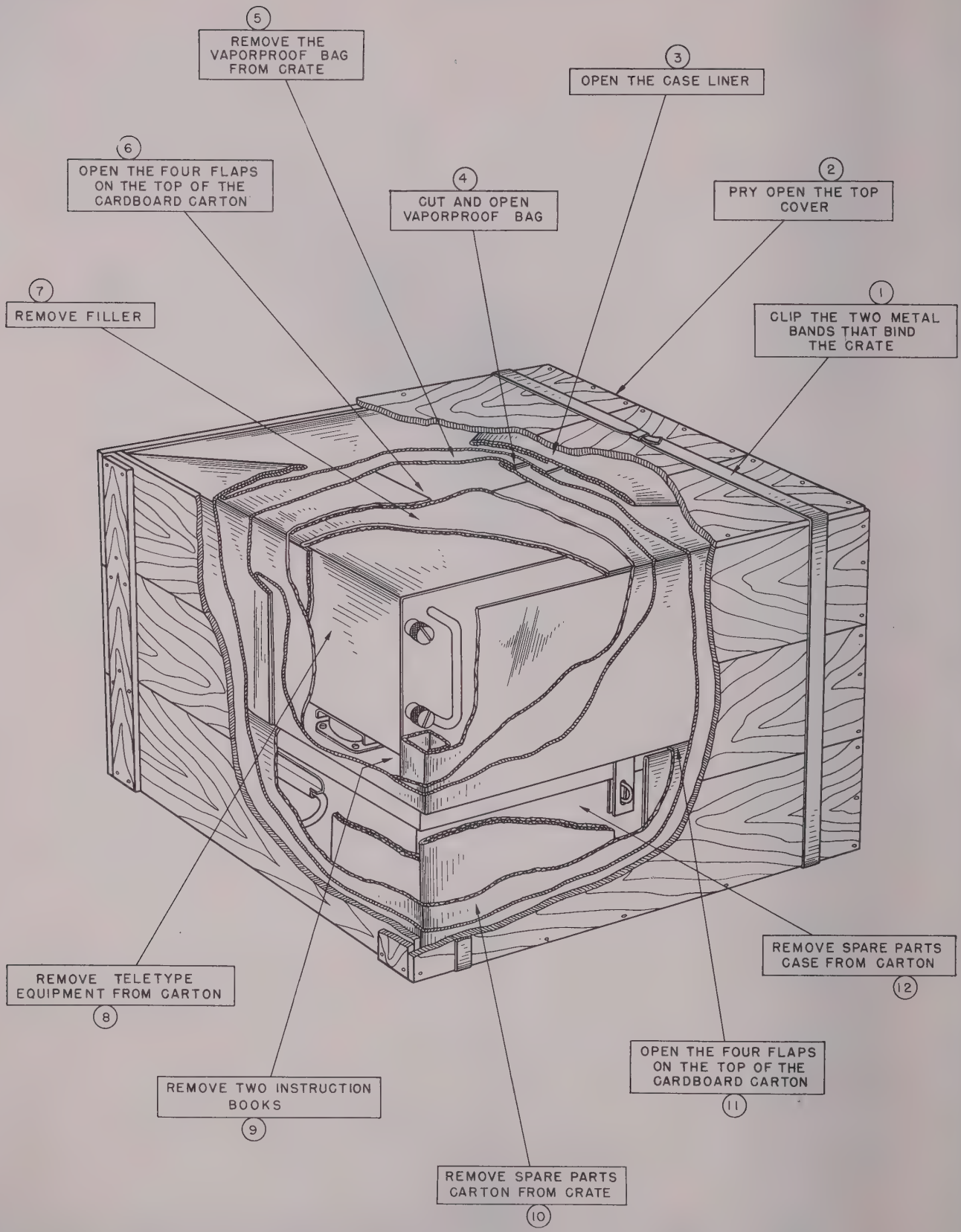


Figure 3—1. Radio Teletype Terminal Set AN/SGC-1, Unpacking Procedure

SECTION 3
INSTALLATION

1. UNPACKING.

The Radio Teletype Terminal Set AN/SGC-1, comprising one TT-40/SGC-1 Teletypewriter Terminal with one full complement of vacuum tubes, spare parts, and two instruction books, is shipped in a single wooden crate. Inside the wooden crate are a waterproof carton, cardboard fillers, vapor-proof container and two inner cardboard cartons containing the equipment and the spare parts box.

Special precautions are necessary only to make certain that the crate is opened from the top and that excessive jars and shocks are not given the equipment during unpacking. Fig. 3—1 shows a cut-a-way view of the packaged equipment and the procedure for unpacking.

2. INSTALLATION.

After unpacking the equipment, it should be inspected for any possible damage that may have resulted from careless handling in transit. Make certain all vacuum tubes are firmly seated in their sockets. Inspection of the chassis and vacuum tubes may be readily effected upon the removal of the chassis from the cabinet. The chassis slides on two stainless steel runners connected to the chassis and cabinet by means of rollers. If the four knurled bolts on the front panel are loosened, the chassis will slide out from the cabinet when it is pulled by the two handles on the front panel. When the chassis is pulled out horizontally as far as possible, a spring snap on each runner catches the edge of the cabinet to prevent the runners from rolling back into the cabinet. Then, if desired, the chassis may be tilted upward for inspection. If it is desired to entirely remove the chassis from the runners and cabinet, the two connecting cables must be disconnected from the chassis and then the chassis may be lifted straight up, from the tilted position, until it is free of the runners.

In planning an installation, care should be exercised to provide adequate clearance between the front of the TT-40/SGC-1 Terminal and the nearest obstruction to enable the withdrawal of the chassis from the cabinet for inspection, servicing, or vacuum tube replacement. (See Fig. 3—2 for dimensions). The cabinet should be secured to the mounting surface by sixteen number 12 machine screws of appropriate length.

Fig. 1—1 shows the equipment with associated units and the connections between units, while Fig. 3—2 shows in detail the cable connections to the TT-40/SGC-1 terminal strip. The terminal strip E-114 is located on the bottom of the cabinet. The first two terminals are marked 115V and should be connected to a single phase, 50/60 cycle, ac power source of 115V. The polarity of the pair of wires connecting to the teletypewriter loop should be determined by means of a voltmeter, after which the positive lead is attached to the terminal mark TTY (+) and the negative lead is connected to the terminal marked TTY (—). In addition, a good ground connection should be provided from the terminal marked GND to a ship's ground. This equipment will not cause hull current. The above connections must be made regardless of the type of radio transmitting and receiving equipment that may be used in conjunction with this installation. The remaining terminals should be connected as appropriate for associated units and as instructed below.

The connections of the audio output of the radio receiver to the TT-40/SGC-1 input terminals (REC) should be shielded. The pair which connects the control terminals (CONT) to the radio transmitter terminals marked REMOTE CONTROL or equivalent need not be shielded. A shielded pair should be used to connect the output terminals (TRANS) to the audio input of the speech amplifier, or the modulator, of the radio transmitter. All shields should be connected to the GND terminal of the TT-40/SGC-1. A movable tap link is provided on the back of the chassis to match the output to either a 600 ohm line or a 50 ohm microphone connection. This link must be connected to the correct tap for proper operation and to prevent damage to the output transformer.

If the Navy transmitter type TDZ and receiver type RDZ units are used with their corresponding remote control-indicator, the input, output, and control connections from the TT-40/SGC-1 may be made to this remote unit instead of directly to the transmitter and receiver. For this purpose, two shielded pairs and one unshielded pair should be used. All shields should be connected to the terminal marked GND. If connections are to be made to the receptacles on the front of the remote unit, the letter designations on the terminal strip in the TT-40/SGC-1 should be followed. The number designations should be followed only if connections are to be made to the terminal strip on the back of the remote unit.

3. INITIAL ADJUSTMENTS.

Prior to turning on the equipment, all external connections should be checked to make certain they are correctly made since serious damage may otherwise result.

Refer to Fig. 4—1 and Fig. 5—4 for the various controls and their functions. When this equipment is first put into service in a given location, a systematic adjustment of all variable controls other than tap switches should be made. The controls marked LOOP CURR, SEND BIAS, REC BIAS, MARK FREQ ADJ and SPACE FREQ ADJ should be rotated fully counter-clockwise and then fully clockwise, after which each control should be set approximately at mid-rotation. The SEND LEVEL ADJ control should be turned fully counter-clockwise for the present time.

The remaining switches and the attenuator (REC LEVEL) will be used during the various conditions of

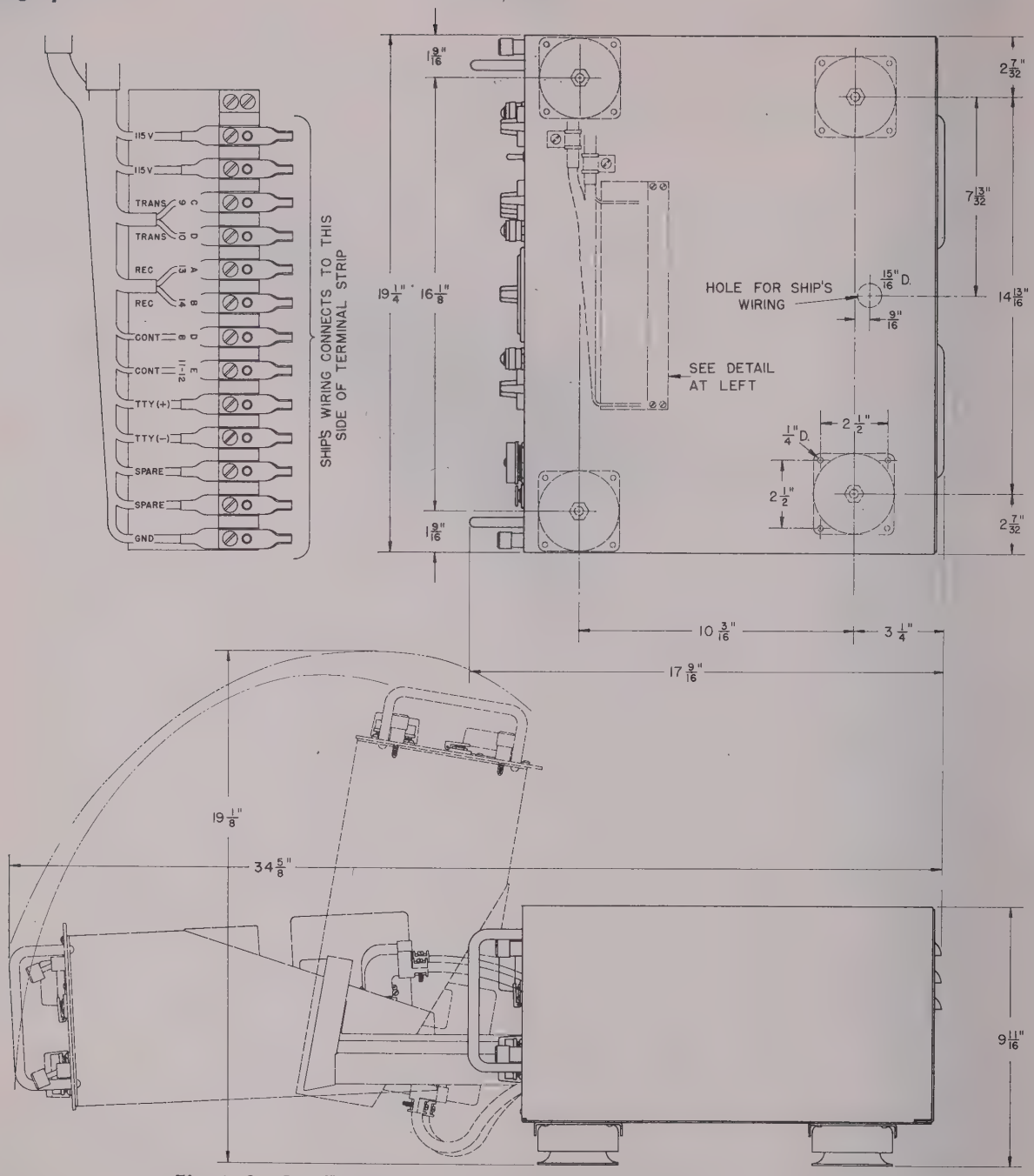


Figure 3—2. Equipment Dimensions, Terminal Strip Connections

operation and for checking the circuits from time to time. The METER SWITCH permits the measurement of various circuits by the indicating meter which shows the signal level, voltage, or current in various circuits. The REC LEVEL attenuator adjusts the level of the received signal. The CONTROL SWITCH selects the desired operating condition. The POWER switch controls the primary voltage to the chassis. The utility outlet is a source of 115 Vac for external use such as for a soldering iron. The monitor jack is for the use of a monitoring teletypewriter. HEADPHONES MUST NOT BE PLUGGED INTO THIS JACK. The POWER indicator light is illuminated when the equipment is energized. The RECEIVE and TRANSMIT lights indicate when the equipment is in the corresponding condition.

The radio transmitter should not be turned on during the preliminary adjustments since it would be energized while some of the adjustments are being made. The operations, as described below, are essential to ensure proper functioning of the Teletype Terminal equipment and must be performed step by step if satisfactory results are to be obtained. During these initial adjustments, the set-

ting of the REC LEVEL control is not critical; a position of about mid-point (at 20 db attenuation) is suitable. The following procedure is to be followed when putting the equipment into use for the first time after installation.

a. See that the teletypewriter is properly connected.

b. Turn the POWER switch ON. The POWER light will go on. Each light is equipped with a dimmer. When the knurled ring is turned counter-clockwise the dimmer is open so that the light is visible.

c. Turn the CONTROL SWITCH to TRS. The TRANSMIT light will turn on after the tubes are warm.

d. Turn the METER SWITCH to LOOP CURR. Adjust the control on the front panel marked LOOP CURR so that the meter reads 60 to the right of center on its upper scale. If it reads to the left, the polarity of the teletypewriter loop is incorrect and the leads should be reversed on the terminal strip on the inside bottom of the cabinet. If the meter reads zero on its upper scale, the source of loop current is probably not energized. If these faulty conditions exist, they must be corrected before proceeding further.

e. Loosen the four thumbscrews on the front panel and pull the chassis out a few inches. Turn the METER SWITCH to SEND LEVEL. Then, with a screwdriver, adjust the control marked SEND LEVEL ADJ until the reading on the lower scale is 0-dbm.

f. Turn the METER SWITCH to PLATE CURR and the CONTROL SWITCH to ADJ FREQ. Then with the screwdriver set the MARK FREQ ADJ control to the point where the meter reading is a maximum to the right.

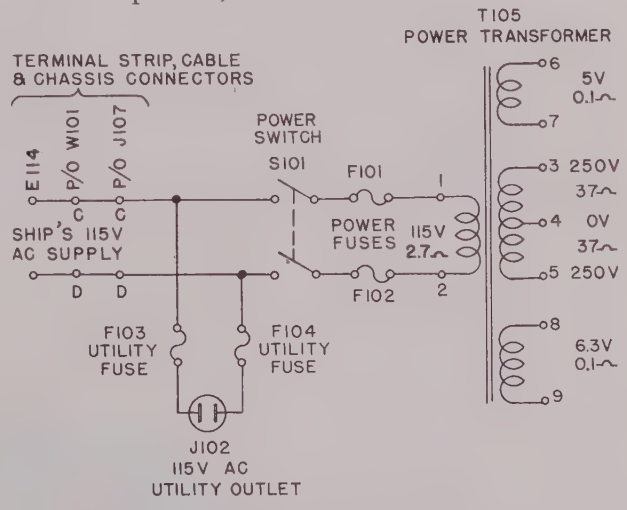
g. If a telephone-type jack plug is available, it may be used as a dummy plug provided it has no connections and it may be inserted in the TTY MONITOR jack. If no dummy plug is available, the operator of the local teletypewriter should hold down the "break" lever during adjustment. Either operation will open the teletypewriter loop. Then rapidly rotate the CONTROL SWITCH to AUTO and back to ADJ FREQ. These operations together cause the Terminal equipment to change to the Space condition. Then set the SPACE FREQ ADJ control to give a maximum meter deflection to the left of center scale. The dummy plug may be removed (or the "break" from the teletypewriter released) and the CONTROL SWITCH returned to AUTO to restore the equipment to normal operating condition.

h. An accurate audio oscillator and an oscilloscope may be used to adjust the Mark and Space frequencies. If these devices are to be used, connect the output of the test oscillator to one amplifier of the oscilloscope and connect the transmitter audio line to the other amplifier. Rotate the CONTROL SWITCH to TRS and, using the test oscillator frequency of 700 cps, set the MARK FREQ ADJ control for a circle pattern on the oscilloscope screen. Open the loop using either method given in paragraph "g" above and, using a test frequency of 500 cps, set the SPACE FREQ ADJ control for a circle pattern. Close the loop. For this test, the internal sweep frequency of the oscilloscope must be disconnected from the horizontal amplifier. The send level should now be readjusted as described in "e" above.

i. Turn the CONTROL SWITCH to AUTO. While holding down the SPACE bar on the teletypewriter rotate the METER SWITCH to SEND BIAS and adjust the SEND BIAS control until the meter reads zero on the upper scale. Turn the METER SWITCH to the OFF position and then release the SPACE bar. When there is only one teletypewriter connected in the loop, it may be noticed that there is no appreciable change in the meter reading when the SEND BIAS control is adjusted. In this case, set the control to mid-position.

j. The radio transmitter may now be turned on and when a teletypewriter signal is being received from a distant station, turn the METER SWITCH to REC LEVEL, setting the REC LEVEL control for 0-dbm (lower scale). If the local teletypewriter is turned on, it will print the incoming message exactly as it is being sent from the distant station.

k. The last adjustment is the REC BIAS control adjustment for which an incoming teletypewriter signal is required from a distant station. Request a distant operator to hold down his teletypewriter space bar for one minute and then await further information. While he is holding down the space bar, turn the METER SWITCH to REC



FUSE	CURRENT	VOLTAGE
F101, F102	1.5A	250
F103, F104	3A	250

Figure 3—3. Primary Power Distribution Diagram

BIAS and adjust the REC BIAS control until the meter reads zero on the upper scale. Then, return the METER SWITCH to the OFF position.

The equipment is now completely adjusted for operation with its associated teletypewriter, receiver, and transmitter for two-way communication with other stations similarly equipped. Fig. 3—3 is a primary power distribution diagram for the TT-40/SGC-1 equipment.

SECTION 4
OPERATION

1. GENERAL.

Teletypewriter Terminal TT-40/SGC-1 is to be used in conjunction with a standard teletypewriter to enable the transmission and reception of teletypewriter messages by radio communication between stations similarly equipped. The Terminal converts the intelligence of outgoing messages to audio tone signals that can be transmitted by a voice-operated radio transmitter. Also, it reconverts the intelligence of incoming signals to a form that can cause a teletypewriter to print the message. Under normal operating conditions little attention is required to maintain proper teletypewriter communication with other stations.

2. OPERATION.

Refer to Fig. 4—1 for the various controls on the front panel and their functions. The numbers on Fig. 4—1 indicate the usual sequence of adjusting the controls. For each adjustment, the METER SWITCH and the CONTROL SWITCH must be turned to the proper position. There are three indicator lights which indicate when the power is on and when the Terminal is in receive or transmit condition. Each light has a dimmer control so that the brilliance of the light may be varied. The light is brightest when the dimmer (the knurled ring) is turned fully counter-clockwise. The 115 Vac outlet is provided for supplying power for external use such as for a soldering iron. This power is not controlled by the POWER switch. The jack is provided for connecting a monitoring teletypewriter into the teletypewriter loop. HEADPHONES MUST NOT BE PLUGGED INTO THIS JACK.

The following procedure should be followed by the operator when putting the equipment into operation after it has been off for a period of time.

a. Turn POWER switch to ON.

b. Turn CONTROL SWITCH to TRS. If the transmitter power has been turned on, the transmitter will send out a continuous tone; however, this does not matter for a few moments. If desired, the transmitter power may be left off until these adjustments have been made.

c. Turn the METER SWITCH to LOOP CURR. Adjust the control marked LOOP CURR until the meter reads 60 on the upper scale. If the meter reads zero, the source of loop current may not be energized.

d. Turn the CONTROL SWITCH to AUTO. Then hold down the space bar on the teletypewriter and turn the METER SWITCH to SEND BIAS. The meter should read zero on the upper scale. If not, correct by means of the SEND BIAS control. Then turn the METER SWITCH back to OFF before releasing the space bar.

e. The radio transmitter may be turned on if it was left off. When a teletype signal is received from a distant station, turn the METER SWITCH to REC LEVEL and adjust the REC LEVEL control until the meter reads 0-dbm (lower scale).

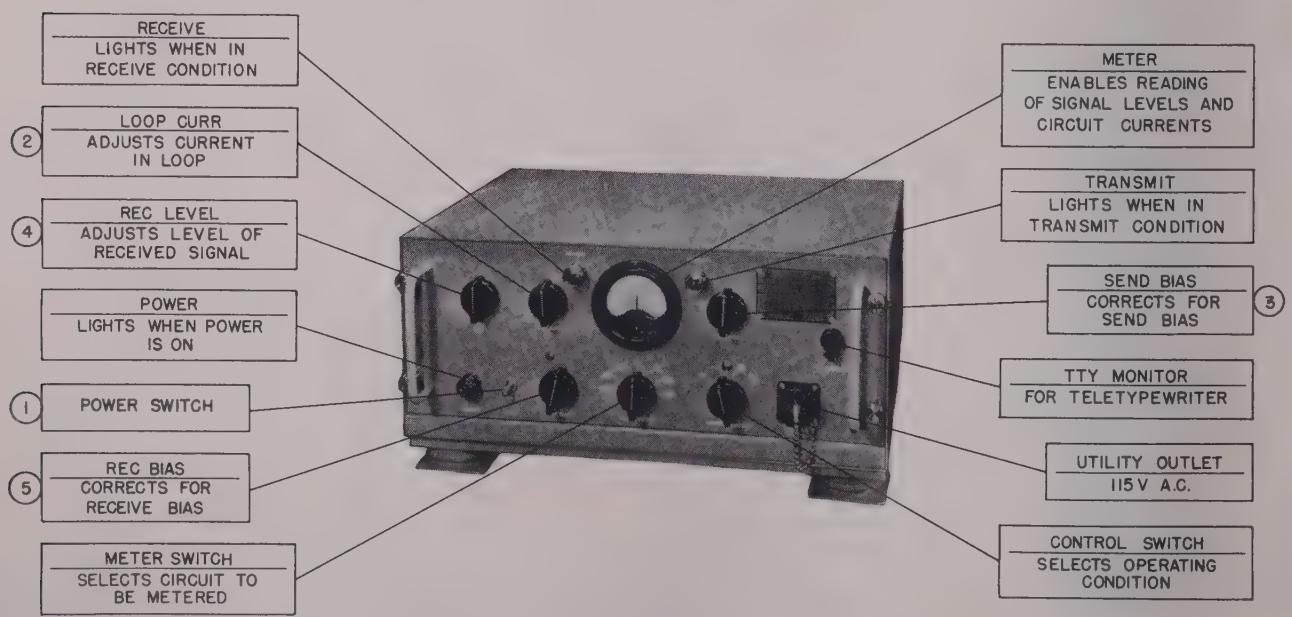


Figure 4—1. Operation Adjustments

f. The last adjustment is the REC BIAS control adjustment for which an incoming teletypewriter signal is required from a distant station. Request a distant operator to hold down his teletypewriter space bar for a minute. While he is holding down the space bar, turn the METER SWITCH to REC BIAS and adjust the REC BIAS control until the meter reads zero on the upper scale. Then, return the METER SWITCH to the OFF position.

The equipment is now adjusted for operation with its associated teletypewriter, receiver, and transmitter for communication with other stations similarly equipped.

The CONTROL SWITCH is used for changing from one operating condition to another. Usually, for one-way reversible communication this switch is set at the AUTO position. In AUTO condition, operators at two or more stations having this equipment may engage in full communication. After a station has completed sending its message, it is ready for reception of any return message after a three second time delay.

In carrying on communications, the equipment should not be operated with the CONTROL SWITCH turned to TRS since the equipment is then locked in the transmit condition and can not receive any message until released by turning the CONTROL SWITCH to one of the other two operating positions. If it is desired to prevent the sending of a message by the teletypewriter, the CONTROL SWITCH may be turned to REC/STDBY. Then the equipment cannot change to transmit condition even though the teletypewriter is operated but it can receive messages or remain in standby condition.

The fourth position of the CONTROL SWITCH is ADJ FREQ. This position is never to be used during operation periods. It is for maintenance use only as explained in Section 5, par. 2.

Since a small time delay is incurred in the operation of the control circuits of the local and distant terminals, the first character transmitted is usually lost. Therefore, the first character typed should be the "letters" key.

3. SUMMARY.

After the Terminal is on and warm, the following sequence should be followed by the operator to check operating conditions.

TABLE 4—1. OPERATION SEQUENCE

CHECK	NOTES OR CAUTIONS	CONTROL SWITCH POSITION	METER SWITCH POSITION	METER READING	CONTROL TO ADJUST
Loop Current		TRS	LOOP CURR	60 upper scale	LOOP CURR
Send Bias	BEFORE TURNING METER SWITCH TO SEND BIAS DEPRESS SPACE BAR AND KEEP IT DEPRESSED UNTIL THIS ADJUSTMENT IS MADE AND SWITCH TURNED TO OFF	AUTO	SEND BIAS	0 upper scale	SEND BIAS
Receive Level	This adjustment requires the reception of a teletype signal.	AUTO	REC LEVEL	0-dbm lower scale	REC LEVEL
Receive Bias	This adjustment requires that the distant operator depress his space bar during the adjustment.	AUTO	REC BIAS	0 upper scale	REC BIAS

FAILURE REPORTS

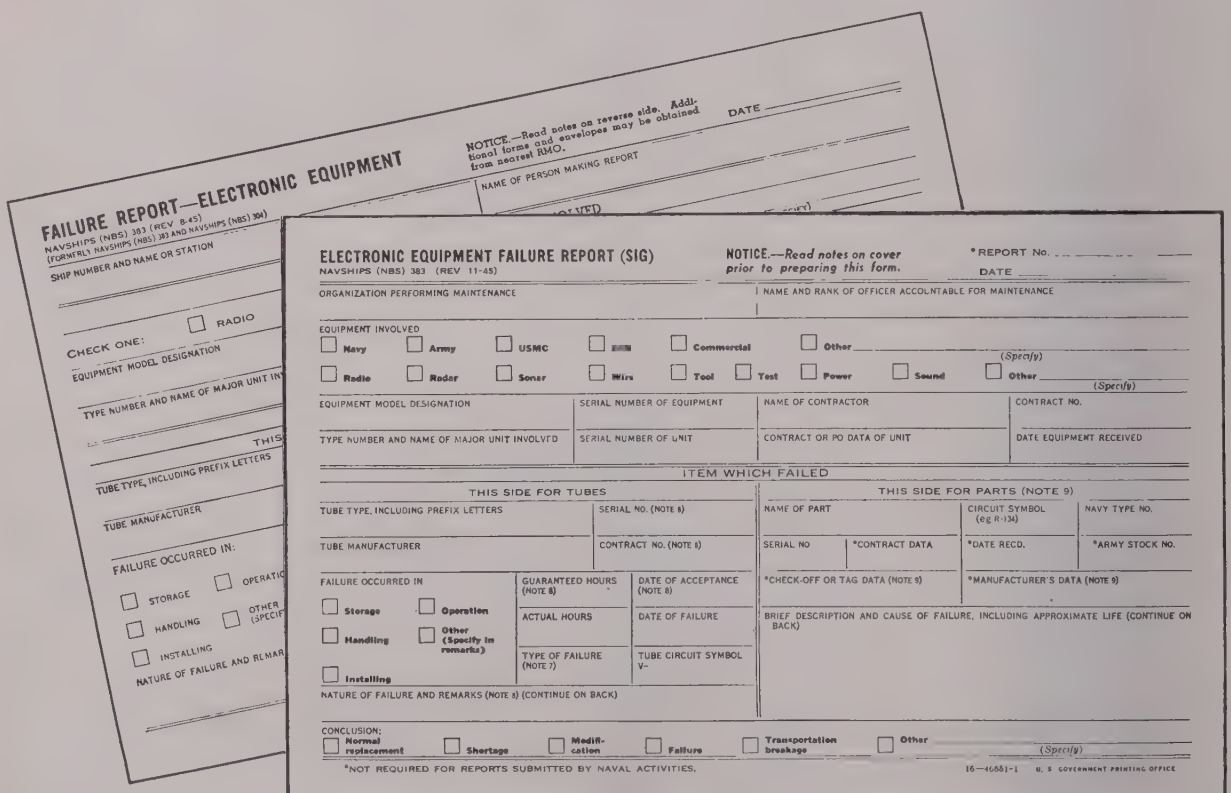
A FAILURE REPORT must be filled out for the failure of any part of the equipment whether caused by defective or worn parts, improper operation, or external influences. It should be made on Failure Report, Form NBS-383, which has been designed to simplfy this requirement. The card must be filled out and forwarded to BUSHIPS in the franked envelope which is provided. Full instructions are to be found on each card.

Use great care in filling the card out to make certain it carries adequate information. For example, under "Circuit Symbol" use the proper circuit identification taken from the schematic drawings, such as T-803, in the case of a transformer, or R-207, for a resistor. Do not substitute brevity for clarity. Use the back of the card to completely describe the cause of failure and attach an extra piece of paper if necessary.

The purpose of this report is to inform BUSHIPS of the cause and rate of failures. The information is used by the Bureau in the design of future equipment and in the maintenance of adequate supplies to keep the present equipment going. The cards you send in, together with those from hundreds of other ships, furnish a store of information permitting the Bureau to keep in touch with the performance of the equipment of your ship and all other ships of the Navy.

This report is not a requisition. You must request the replacement of parts through your Officer-in-Charge in the usual manner.

Make certain you have a supply of Failure Report cards and envelopes on board. They may be obtained from the nearest District Publications and Printing Office.



FAILURE REPORT—ELECTRONIC EQUIPMENT
NAVSHIPS (NBS) 383 (REV 8-45)
(FORMERLY NAVSHIPS (NBS) 383 AND NAVSHIPS (NBS) 384)
SHIP NUMBER AND NAME OR STATION
CHECK ONE: RADIO
EQUIPMENT MODEL DESIGNATION
TYPE NUMBER AND NAME OF MAJOR UNIT IN
TUBE TYPE, INCLUDING PREFIX LETTERS
TUBE MANUFACTURER
FAILURE OCCURRED IN:
STORAGE
HANDLING
INSTALLING
NATURE OF FAILURE AND REMAR
NOTICE.—Read notes on reverse side. Additional forms and envelopes may be obtained from nearest RMO.
DATE
NAME OF PERSON MAKING REPORT

ELECTRONIC EQUIPMENT FAILURE REPORT (SIG)
NAVSHIPS (NBS) 383 (REV 11-45)
NOTICE.—*Read notes on cover prior to preparing this form.*
*REPORT No.
DATE
ORGANIZATION PERFORMING MAINTENANCE
NAME AND RANK OF OFFICER ACCOUNTABLE FOR MAINTENANCE
EQUIPMENT INVOLVED
Navy Army USMC Commercial Other (Specify)
Radio Radar Sonar Wire Tool Test Power Sound Other (Specify)
EQUIPMENT MODEL DESIGNATION | SERIAL NUMBER OF EQUIPMENT | NAME OF CONTRACTOR | CONTRACT NO.
TYPE NUMBER AND NAME OF MAJOR UNIT INVOLVED | SERIAL NUMBER OF UNIT | CONTRACT OR PO DATA OF UNIT | DATE EQUIPMENT RECEIVED
ITEM WHICH FAILED
THIS SIDE FOR TUBES
TUBE TYPE, INCLUDING PREFIX LETTERS | SERIAL NO. (NOTE 8)
TUBE MANUFACTURER | CONTRACT NO. (NOTE 8)
FAILURE OCCURRED IN: Storage, Operation, Handling, Other (Specify in remarks), Installing
GUARANTEED HOURS (NOTE 8) | DATE OF ACCEPTANCE (NOTE 8)
ACTUAL HOURS | DATE OF FAILURE
TYPE OF FAILURE (NOTE 7) | TUBE CIRCUIT SYMBOL V-
NATURE OF FAILURE AND REMARKS (NOTE 6) (CONTINUE ON BACK)
THIS SIDE FOR PARTS (NOTE 9)
NAME OF PART | CIRCUIT SYMBOL (eg R-134) | NAVY TYPE NO.
SERIAL NO | *CONTRACT DATA | *DATE RECD. | *ARMY STOCK NO.
*CHECK-OFF OR TAG DATA (NOTE 5) | *MANUFACTURER'S DATA (NOTE 9)
BRIEF DESCRIPTION AND CAUSE OF FAILURE, INCLUDING APPROXIMATE LIFE (CONTINUE ON BACK)
CONCLUSION: Normal replacement, Shortage, Modification, Failure, Transportation breakage, Other (Specify)
*NOT REQUIRED FOR REPORTS SUBMITTED BY NAVAL ACTIVITIES.
16—46581-1 U. S. GOVERNMENT PRINTING OFFICE

Figure 5—1. Failure Report, Sample Form

SECTION 5
MAINTENANCE

1. GENERAL.

This section of the instruction book contains diagrams, charts, and other pertinent data useful in servicing of the TT-40/SGC-1 Teletypewriter Terminal. This equipment does not require periodic adjustments, although it does require the normal operation adjustments that are made when the equipment is turned on or when the level of the received signal changes grossly. These normal operation adjustments were described in Section 4 titled "Operation", and consisted of front panel adjustments.

The remaining adjustments are for the three controls on the right side of the chassis which are reached by pulling the chassis out of the cabinet a few inches. These controls remain in correct adjustment over long periods so usually the only time that they need adjusting is after replacing the oscillator or output tubes or after servicing of the equipment. The adjustment of these controls normally is performed by the technician to ensure proper operation of the equipment. However, if during battle conditions the equipment becomes faulty, the operator may be called upon to check these controls or to replace fuses or tubes.

To facilitate inspection and servicing of the chassis, the chassis may be pulled out from the cabinet and tilted up by first loosening the four knurled retaining screws on the front panel.

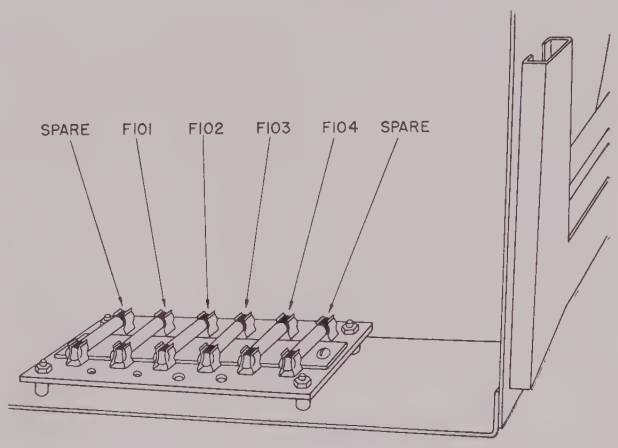


Figure 5—2. Fuse Locations, Chassis Tilted Up

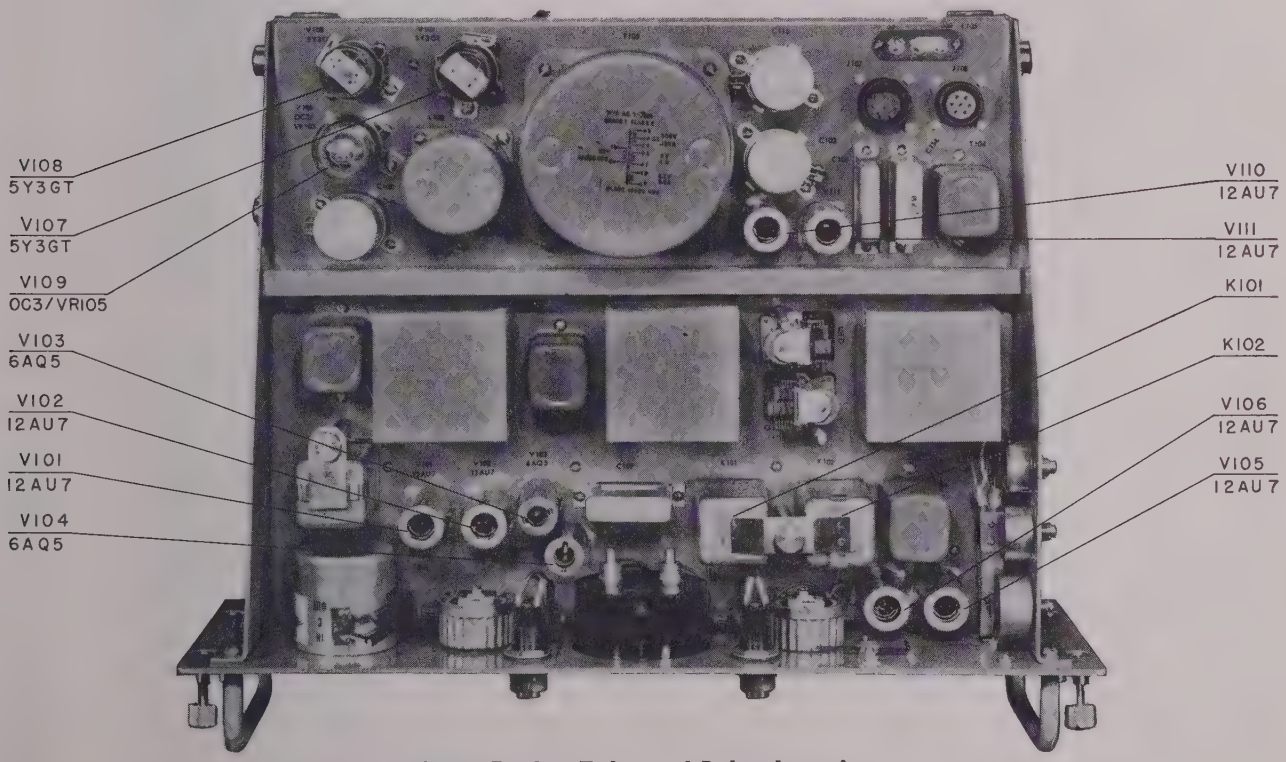


Figure 5—3. Tube and Relay Locations

2. EMERGENCY MAINTENANCE.

Notice to Operators

Operators shall not perform any of the following emergency maintenance procedures without proper authorization.

Fig. 5—2 shows the location of the four fuses. They are located on one fuse board with two spare fuses. Table 5—1, shown below, lists symptoms of fuse failure and information pertinent to fuse replacement.

Fig. 5—3 shows the location of the tubes and polar relays. If the operation of the Teletypewriter Terminal is faulty, visual inspection will determine if the tube filaments are drawing current. If the tube does not have at least a small glow it should be exchanged. The tubes may be checked with a standard tube tester. The spare polar relay is on the left side near the front panel and, after loosening the top clamp, may be used to replace either K-101 or K-102. The POWER switch should be turned off while K-101 is being removed or replaced in its socket to prevent damage to V-103 and V-104.

Note

ALL TUBES OF A GIVEN TYPE SUPPLIED WITH THE EQUIPMENT SHALL BE CONSUMED PRIOR TO EMPLOYMENT OF TUBES FROM GENERAL STOCK.

Fig. 5—4 shows the location of the side controls which are the SEND LEVEL ADJ, MARK FREQ ADJ, and SPACE FREQ ADJ controls. If the oscillator tube V-105 is replaced, the adjustment of the Mark and Space frequencies should be checked as outlined below. If the output tube V-106 is replaced, the adjustment of the sending level should be checked as also outlined below.

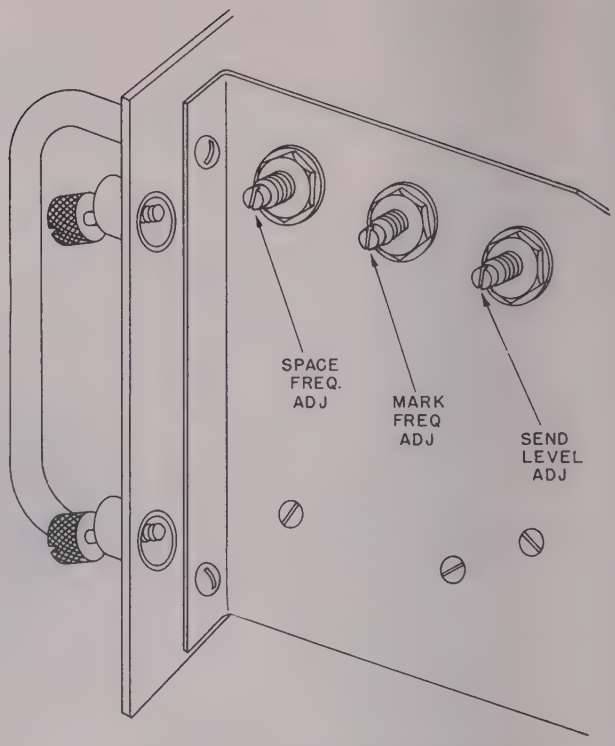


Figure 5—4. Send Tone Controls

a. SEND LEVEL ADJ. Turn the METER SWITCH to SEND LEVEL and the CONTROL SWITCH to TRS.

WARNING

Never replace a fuse with one of higher rating unless continued operation of the equipment is more important than probable damage. If a fuse burns out immediately after replacement, do not replace it a second time until the cause has been corrected.

TABLE 5—1. FUSE REPLACEMENT

SYMPTOM	BLOWN FUSE	VALUE (amps)	COMMENTS
Equipment inoperative and POWER light does not light.	F-101 and/or F-102	1½	Check power cable connections if utility outlet is also dead.
Utility outlet dead.	F-103 and/or F-104	3	

Then adjust the control marked SEND LEVEL ADJ until the meter reads 0-dbm (lower scale).

b. MARK FREQ ADJ. Turn the METER SWITCH to PLATE CURR and the CONTROL SWITCH to ADJ FREQ. Then adjust the MARK FREQ ADJ control to the point where the meter reading is a maximum to the right.

c. SPACE FREQ ADJ. If a telephone-type jack plug is available, it may be used as a dummy plug provided it has no connections and it may be inserted in the TTY MONITOR jack. If no dummy plug is available, the operator of the local teletypewriter should hold down the "break" lever during the adjustment. Either operation will open the teletypewriter loop. Then rapidly rotate the CONTROL SWITCH to AUTO and back to ADJ FREQ. These operations together cause the Terminal to change to Space condition. Then adjust the SPACE FREQ ADJ control until the meter reads maximum to the left. The dummy plug may be removed or the "break" from the teletypewriter released and the CONTROL SWITCH returned to the desired operating position.

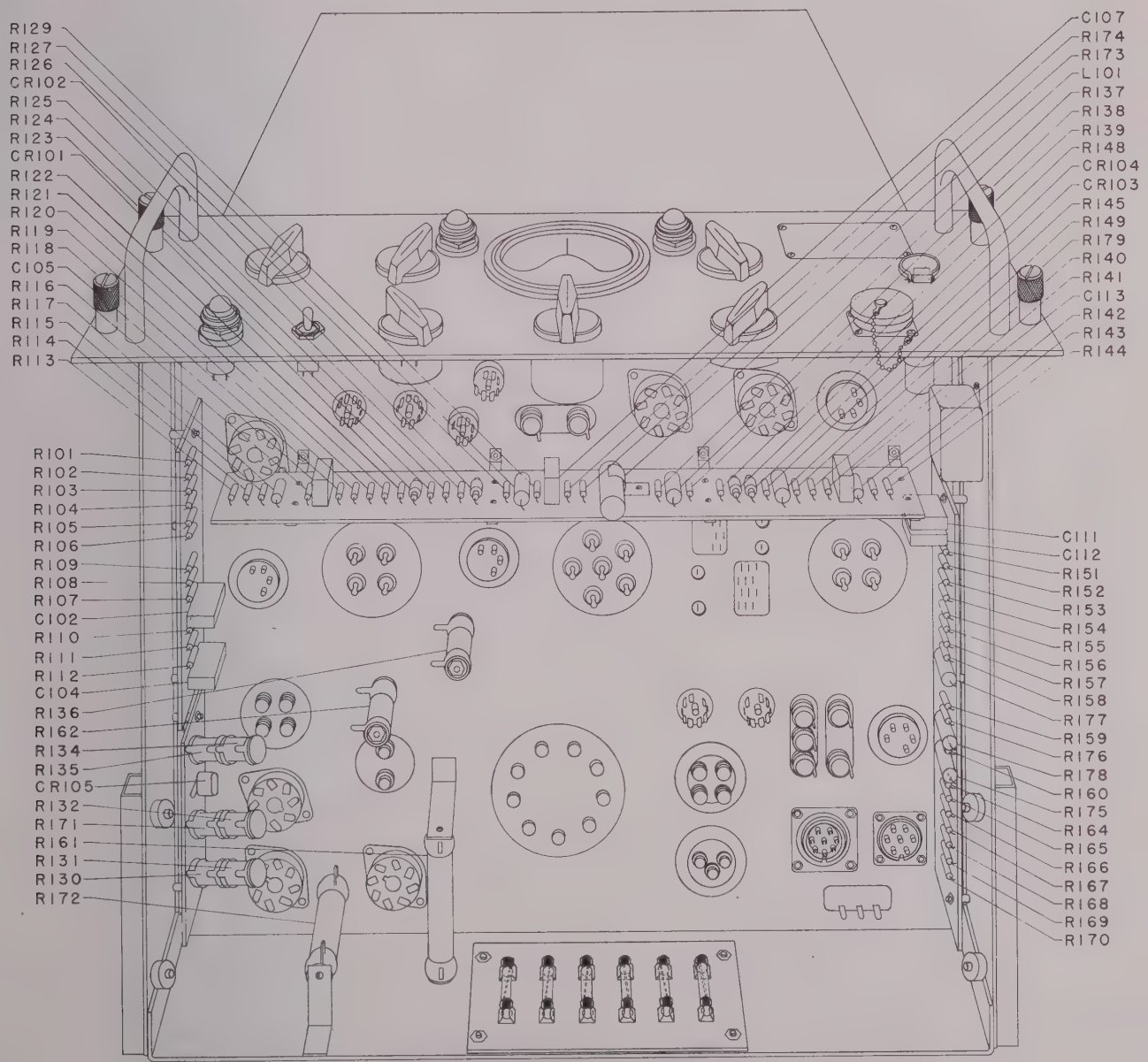
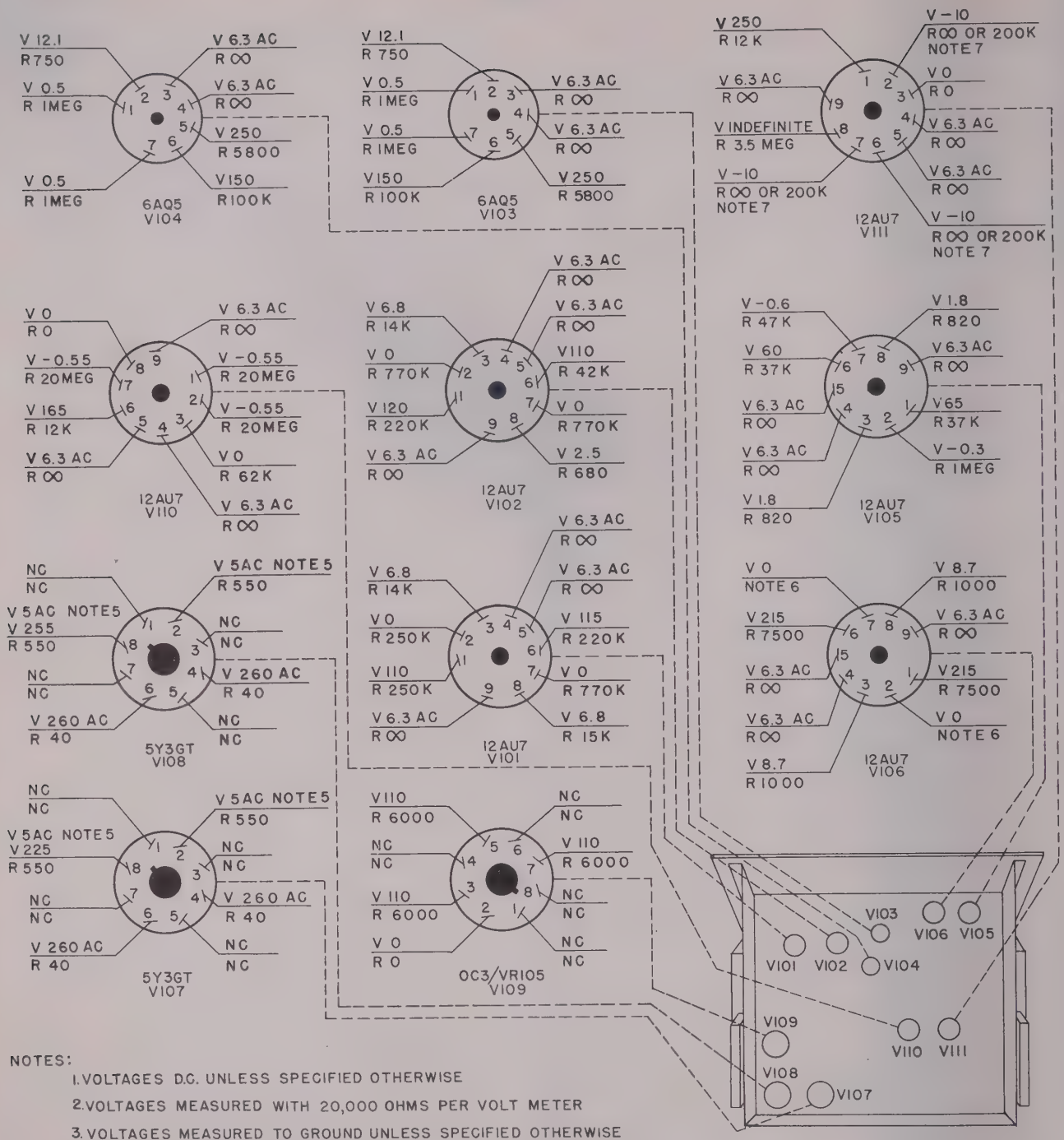


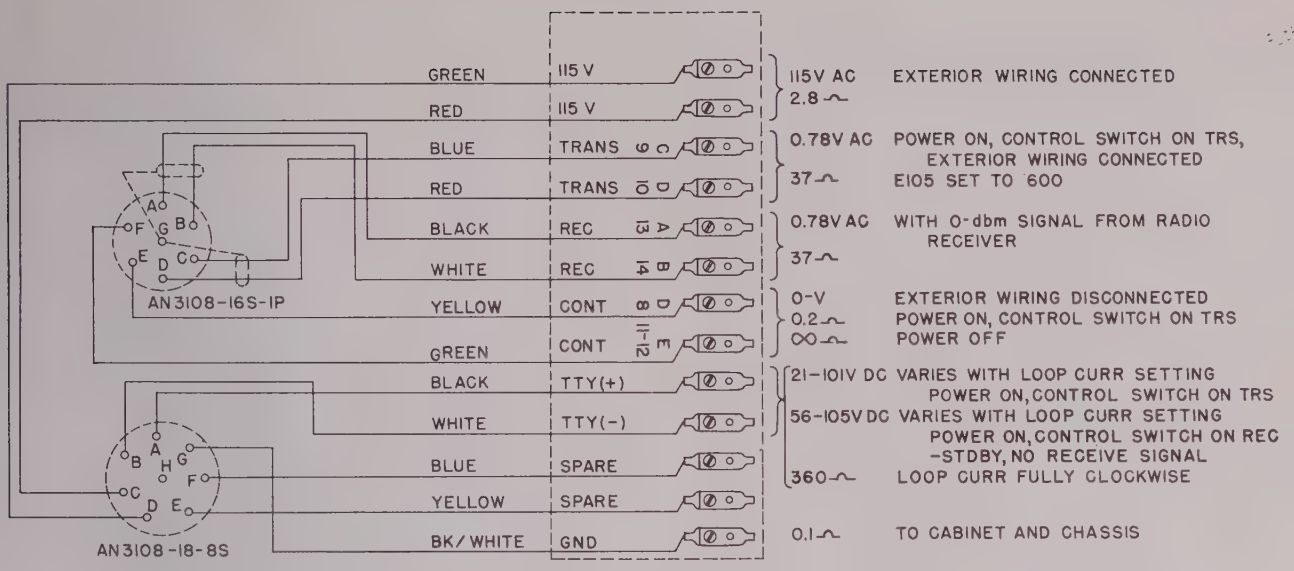
Figure 5—5. Component Locations



NOTES:

1. VOLTAGES D.C. UNLESS SPECIFIED OTHERWISE
2. VOLTAGES MEASURED WITH 20,000 OHMS PER VOLT METER
3. VOLTAGES MEASURED TO GROUND UNLESS SPECIFIED OTHERWISE
4. CONDITIONS OF EQUIPMENT:
   a. POWER SWITCH TURNED OFF FOR RESISTANCE READINGS
   b. POWER SWITCH TURNED ON FOR VOLTAGE READINGS
   c. CONTROL SWITCH IN AUTO. POSITION FOR ALL READINGS
   d. METER SWITCH IN OFF POSITION FOR ALL READINGS
   e. REC. BIAS CONTROL (R128) AT MIDPOINT
5. 5V AC. BETWEEN TUBE PINS 2 AND 8
6. RESISTANCE VALUE DEPENDS ON SETTING OF SEND LEVEL ADJ. (R150) MAX. VALUE 500K
7. RESISTANCE VALUE DEPENDS ON CONDITION OF SEND RELAY (K102)

Figure 5—6. Tube Voltage and Resistance Chart



NOTE: OPEN CIRCUIT BETWEEN GND. TERMINAL AND ALL OTHER TERMINALS

Figure 5—7. Voltage and Resistance Diagram, Terminal Strip and Cable

3. CORRECTIVE MAINTENANCE.

Normally, the first step in correcting any trouble or failure which may occur in any electronic device is to isolate the section of the circuit which is the source of the trouble. However, due to the two control circuits and the interlocking features of the receive and transmit circuits, it is difficult to analyze this system section by section and trouble in one section may manifest itself in another seemingly unrelated section. Therefore, it is advisable to make a thorough check of the system function by function as outlined in the trouble shooting chart Table 5—2.

Fig. 5—6 is a chart showing the voltages and resistances between each tube socket pin and ground. This chart is provided as a standard so that faulty equipment may be quickly compared in regard to voltages and resistances.

Fig. 5—7 is a diagram showing the voltage and resistance measurements on the terminal strip in the cabinet. This strip has two flexible cables connected between it and the chassis and is the attachment point for the exterior wiring. The flexible cables are attached to the chassis with two AN- connectors shown in this figure. All resistance measurements must be made with the exterior wiring disconnected as the values shown represent resistances of only the interior components of the TT-40/SGC-1 Teletypewriter Terminal.

An oscilloscope may be used to advantage in locating and correcting faulty components. Representative oscilloscope patterns are shown in Fig. 5—8 to enable a comparative visual check of the signal as it passes through the system. These patterns are shown associated with the point in the circuit where they may be observed. The oscilloscope should be connected between ground and the desired point in the circuit except when the input or output signal pattern is to be observed. To observe these patterns connect the oscilloscope to both sides of the audio line. These lines float in respect to ground so that an oscilloscope connected to ground and one side of the audio line would not produce the pattern present in the line. The first pattern shown in Fig. 5—8 has spikes in the amplitude of the wave which indicate that noise is present in the signal. A quiet signal will not contain these spikes. The pattern at the input of the frequency-discriminator filter Z-102 and the pattern at the input of the output band-pass filter Z-103 both show distortion to be present. Although distortion is actually present at these points, it is accentuated by the filters because they pass the undistorted signal voltages and reflect the remaining distorted voltages.

Fig. 5—9 is a schematic of the entire system showing the electrical circuits. Fig. 5—10 is a wiring diagram showing the actual point to point connections to enable tracing the cable wires throughout the chassis.

Since corrective maintenance often affects adjustments, the maintenance personnel should check all adjustments properly. The complete adjustment procedures are repeated here. These adjustments must be performed step by step if satisfactory results are to be obtained. During the following adjustments the setting of the REC LEVEL control is not critical; a position of about mid-point (at 20 db attenuation) is suitable.

a. Turn POWER switch to ON.

b. Turn CONTROL SWITCH to TRS. If the radio transmitter power has been turned on, the transmitter will send out a continuous tone; however, this does not matter for a few moments. If desired, the transmitter power may be turned off until these adjustments have been made.

c. Turn the METER SWITCH to LOOP CURR. Adjust the control marked LOOP CURR until the meter reads 60 on the upper scale. If the meter reads zero, the source of loop current may not be energized.

d. Turn the METER SWITCH to SEND LEVEL. Then, with a screw driver, adjust the control marked SEND LEVEL ADJ until the reading on the lower scale is 0-dbm.

e. Turn the METER SWITCH to PLATE CURR and the CONTROL SWITCH to ADJ FREQ. Then with the screw driver set the MARK FREQ ADJ control to the point where the meter reading is a maximum to the right.

f. If a telephone-type jack plug is available, it may be used as a dummy plug provided it has no connections and it may be inserted in the TTY MONITOR jack. If no dummy plug is available, the operator of the local teletypewriter should hold down the "break" lever during adjustment. Either operation will open the teletypewriter loop. Then rapidly rotate the CONTROL SWITCH to AUTO and back to ADJ FREQ. These operations together cause the Terminal equipment to change to the Space condition. Then set the SPACE FREQ ADJ control to give a maximum meter deflection to the left of center scale. The dummy plug may be removed (or the "break" from the teletypewriter released) and the CONTROL SWITCH returned to AUTO to restore the equipment to normal operating condition.

g. An accurate audio oscillator and an oscilloscope may be used to adjust the Mark and Space frequencies. If these devices are to be used, connect the output of the test oscillator to one amplifier of the oscilloscope and connect the transmitter audio line to the other amplifier. Rotate the CONTROL SWITCH to TRS and, using the test oscillator frequency of 700 cps, set the MARK FREQ ADJ control for a circle pattern on the oscilloscope screen. Open the loop using either method given in paragraph "f" above and, using a test frequency of 500 cps, set the SPACE FREQ ADJ control for a circle pattern. Close the loop. For this test, the internal sweep frequency of the oscilloscope must be disconnected from the horizontal amplifier. The send level should now be readjusted as described in "d" above.

h. Turn the CONTROL SWITCH to AUTO. While holding down the SPACE bar on the teletypewriter rotate the METER SWITCH to SEND BIAS and adjust the SEND BIAS control until the meter reads zero on the upper scale. Then turn the METER SWITCH back to OFF before releasing the space bar. When there is only one teletypewriter connected in the loop, it may be noticed that there is no appreciable change in the meter reading when the SEND BIAS control is adjusted. In this case, set the control to mid-position.

i. The radio transmitter may now be turned on if it had been turned off. When a teletype signal is received from a distant station, turn the METER SWITCH to REC LEVEL and adjust the REC LEVEL control until the meter reads 0-dbm (lower scale).

j. The last adjustment is the REC BIAS control adjustment for which an incoming teletypewriter signal is required from a distant station. Request a distant operator to hold down his teletypewriter space bar for one minute and then await further information. While he is holding down the space bar, turn the METER SWITCH to REC BIAS and adjust the REC BIAS control until the meter reads zero on the upper scale. Then, return the METER SWITCH to the OFF position.

The equipment is now completely adjusted for operation with its associated teletypewriter, receiver, and transmitter for two-way communication with other stations similarly equipped.

TABLE 5—2. TROUBLE SHOOTING CHART

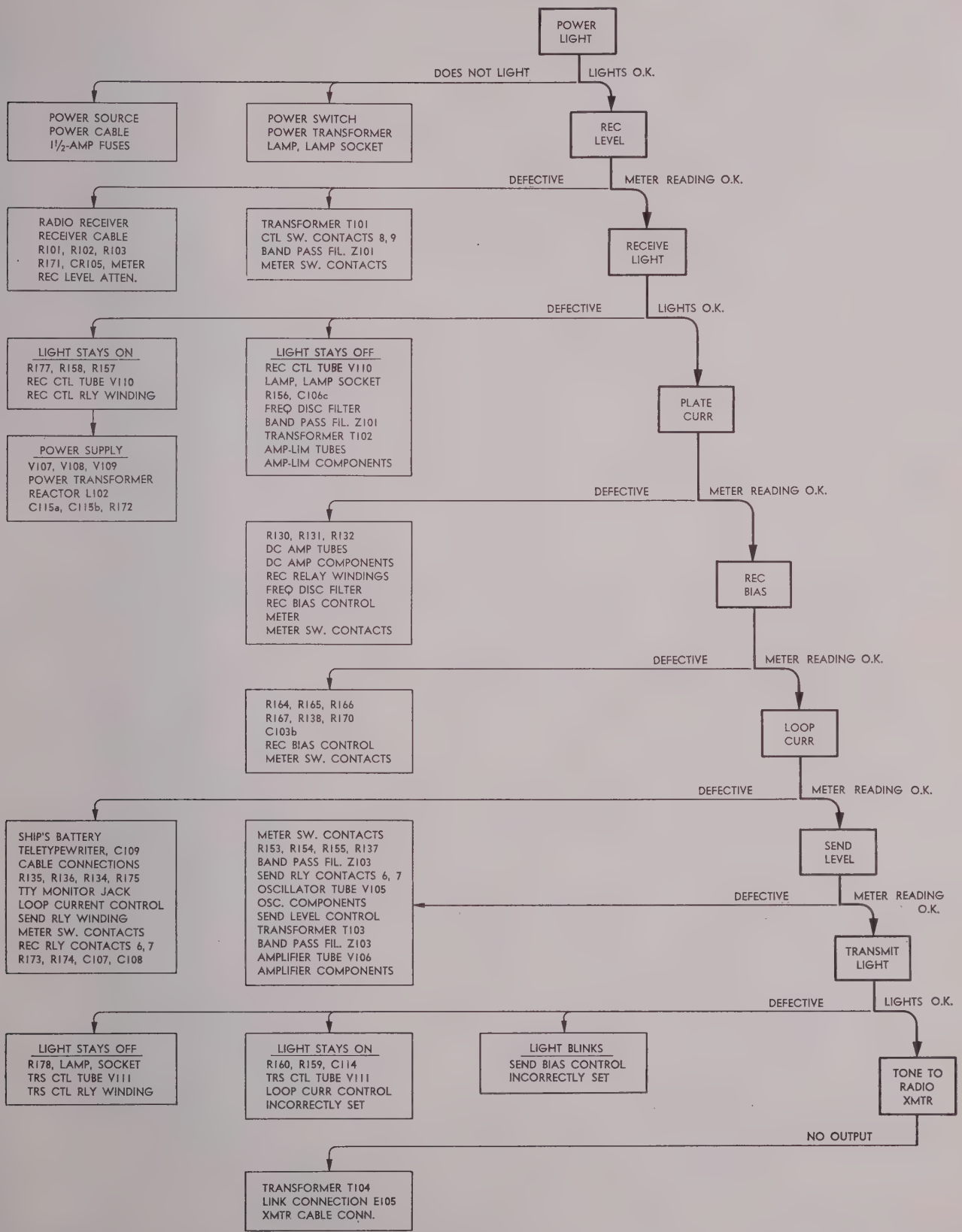


TABLE 5—3. WINDING DATA

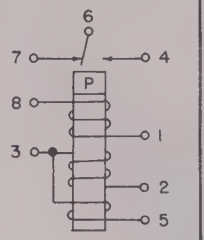
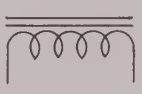
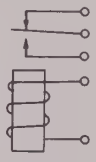
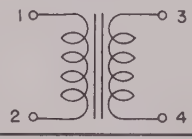
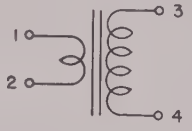
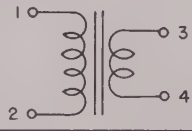
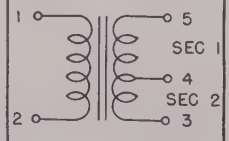
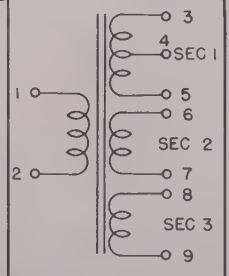
SYMBOL	REMLER PART NO.	DIAGRAM	WINDING	WIRE SIZE	TURNS	D.C. RES.	IMP. RATIO	HI-V INSUL	REMARKS
K-101 K-102	L-40207		Differential Winding 1-8 Winding 2-3 Winding 3-5	 #37E #37E #37E	 2,375 2,375 350	 150 150 20		 500V 500V 500V	Hermetically sealed. Plugs into octal socket.
L-101	L-30306		Grouped Single			48			Inductance 2.5 mh. Hermetically sealed.
L-102	L-30337		Single	#33E	3,400	260		1,500V	Inductance 8 hy at 80 ma. Hermetically sealed.
O-101 O-102	L-40209 L-40210		Single	#40E	24,800	3,600			Receive Rly contacts 1A2B2C Transmit Rly contacts 5A.
T-101	L-30285		Primary Secondary	#34E #34E	820 820	36.8 50.9	1:1	700V	600 ohm line to 600 ohm line. Hermetically sealed. Electrostatic shield-connected to case.
T-102	L-30289		Primary Secondary	#35E #42E	396 4,970	30.0 1,430	1:167	700V	600 ohm line to 100 K ohm grid. Hermetically sealed. Electrostatic shield connected to case.
T-103	L-30288-1		Primary Secondary	#38E #34E	2,620 718	381 54.8	13.3:1	1,500V	8,000 ohm plate to 600 ohm line. Primary may carry 20 ma. Hermetically sealed.
T-104	L-30286		Primary Sec. 1 Sec. 2	#34E #34E #31E	682 484 198	34.6 30.0 6.8	12.0 6.0 1.0	700V 700V 700V	600 ohm line to 600 ohm line tapped @ 50 ohm. Hermetically sealed. Electrostatic shield connected to case.
T-105	L-30338		Primary Sec. 1 Sec. 2 Sec. 3	21E 28E 14E 16E	383 1,744 18 22.5	2.7 74.0 0.1 0.1		1,500V 1,500V 1,500V 1,500V	Primary 115V 50/60 cycle ± 10%. Sec #1 500V CT 150 MA Sec #2 5.0V @4 amps. Sec #3 6.3V @3.5 amps. Hermetically sealed.

TABLE 5—4. TUBE CHARACTERISTICS

TUBE TYPE	FILAMENT VOLT. (V)	FILAMENT CURR. (A)	PLATE VOLT. (V)	GRID BIAS (V)	SCREEN VOLT. (V)	PLATE CURR (Ma)	SCREEN CURR (Ma)	AC PLATE RES. (Ohms)	AMP FACT. (Mu)	TRANSCONDUCTANCE		EMISSION	
										Normal	Minimum	Is (Ma)	Test Volts
OC3/ VR105			105			5 to 40							
5Y3GT	5.0	2.0	#1			#1						125 #2	75
6AQ5	6.3	0.45	250	—12.5	250	45.0	4.5	52,000	213	4100	3000	50	50
12AU7 #3	6.3/ 12.6	0.3/ 0.15	250	—8.5		10.5		7,700	17	2200	1600	20	30

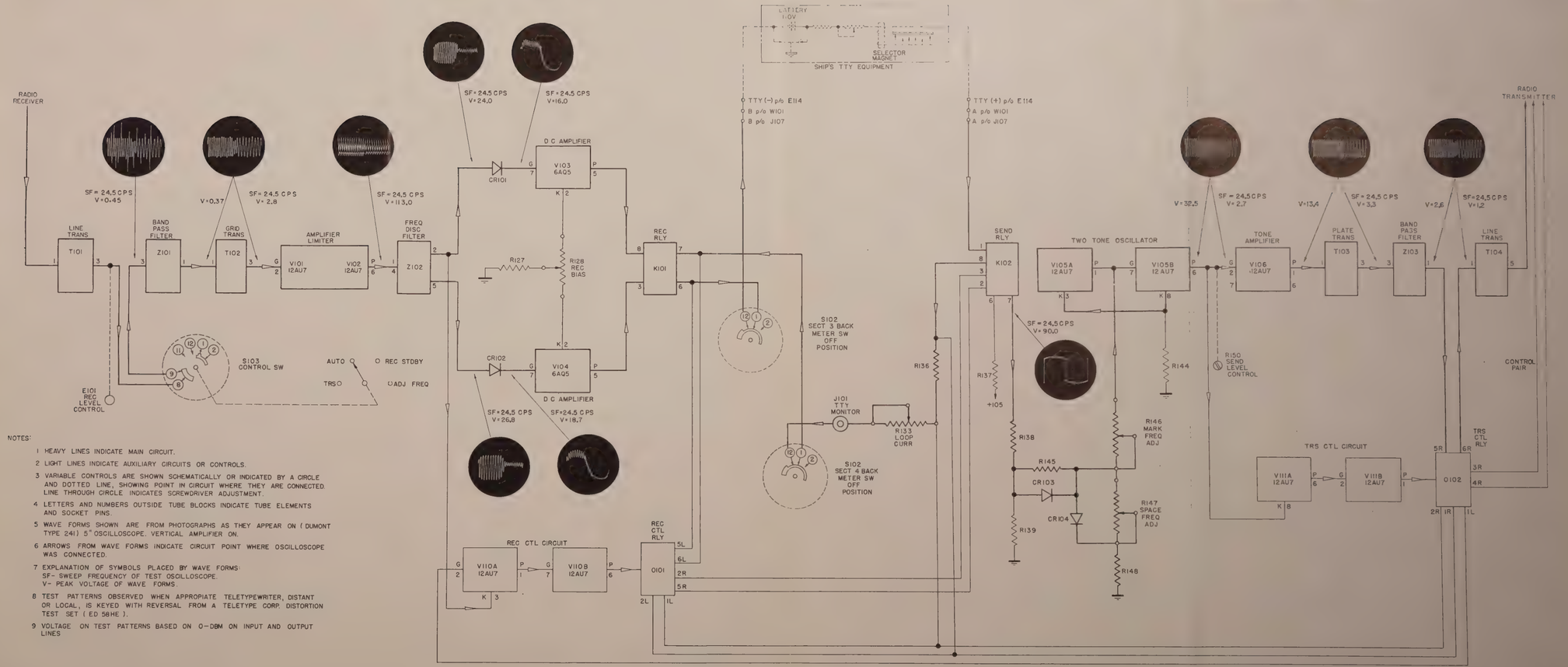
#1 For condenser-input filter: AC plate voltage per plate (RMS): 350 volts (max.); DC output current: 125Ma (max.)

#2 Each diode.

#3 Each triode section.

TABLE 5—5. TUBE OPERATING VOLTAGES AND CURRENTS

TUBE	TYPE	FUNCTION	PLATE (E)	PLATE (MA)	SCREEN (E)	SCREEN (MA)	SUPP (E)	CATH (E)	GRID (E)	HEATER (E) AC
V-101A	12AU7	AMP-LIM	110	0.46				6.8	0	6.3
V-101B	12AU7	AMP-LIM	115	0.46				6.8	0	6.3
V-102A	12AU7	AMP-LIM	120	0.46				6.8	0	6.3
V-102B	12AU7	AMP-LIM	110	3.5				2.5	0	6.3
V-103	6AQ5	DC AMP	250	9.6	150	0.4	12.1	12.1	0.5	6.3
V-104	6AQ5	DC AMP	250	9.6	150	0.4	12.1	12.1	0.5	6.3
V-105A	12AU7	Multi-vibrator	65	1.0				1.8	—0.3	6.3
V-105B	12AU7	Multi-vibrator	60	1.2				1.8	—0.6	6.3
V-106A	12AU7	Ampli-fier	215	4.4				8.7	0	6.3
V-106B	12AU7	Ampli-fier	215	4.4				8.7	0	6.3
V-107	5Y3	Recti-fier	250AC	75.0						5.0
V-108	5Y3	Recti-fier	250AC	75.0						5.0
V-109	OC3/ VR150	Voltage Reg.	110	5 to 40						
V-110A	12AU7	Rec Ctl	0.55	0				0	—0.55	6.3
V-110B	12AU7	Rec Ctl	165	12.3				0	—0.55	6.3
V-111A	12AU7	Trs Ctl	10.0	0				0	—10.0	6.3
V-111B	12AU7	Trs Ctl	250.0	0				0	—10.0	6.3

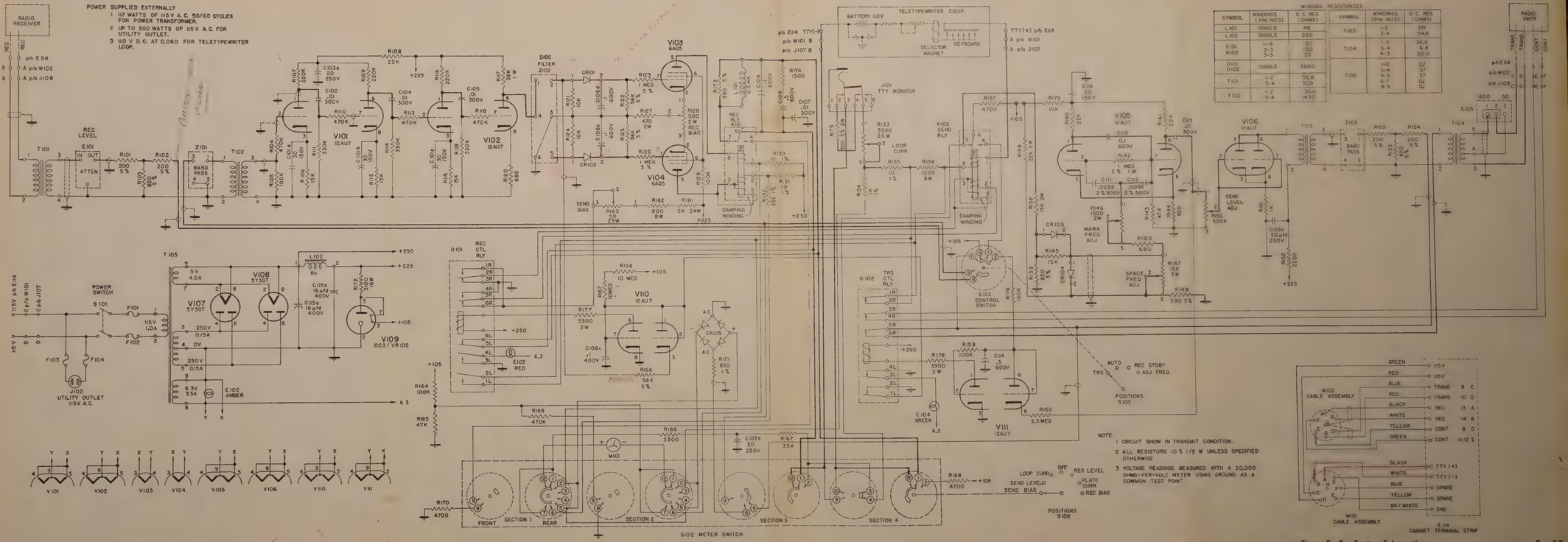


NOTES:

1. HEAVY LINES INDICATE MAIN CIRCUIT.
2. LIGHT LINES INDICATE AUXILIARY CIRCUITS OR CONTROLS.
3. VARIABLE CONTROLS ARE SHOWN SCHEMATICALLY OR INDICATED BY A CIRCLE AND DOTTED LINE, SHOWING POINT IN CIRCUIT WHERE THEY ARE CONNECTED. LINE THROUGH CIRCLE INDICATES SCREWDRIVER ADJUSTMENT.
4. LETTERS AND NUMBERS OUTSIDE TUBE BLOCKS INDICATE TUBE ELEMENTS AND SOCKET PINS.
5. WAVE FORMS SHOWN ARE FROM PHOTOGRAPHS AS THEY APPEAR ON (DUMONT TYPE 241) 5" OSCILLOSCOPE. VERTICAL AMPLIFIER ON.
6. ARROWS FROM WAVE FORMS INDICATE CIRCUIT POINT WHERE OSCILLOSCOPE WAS CONNECTED.
7. EXPLANATION OF SYMBOLS PLACED BY WAVE FORMS:
   SF- SWEEP FREQUENCY OF TEST OSCILLOSCOPE.
   V- PEAK VOLTAGE OF WAVE FORMS.
8. TEST PATTERNS OBSERVED WHEN APPROPIATE TELETYPEWRITER, DISTANT OR LOCAL, IS KEYED WITH REVERSAL FROM A TELETYPE CORP. DISTORTION TEST SET (ED 58HE).
9. VOLTAGE ON TEST PATTERNS BASED ON 0-DBM ON INPUT AND OUTPUT LINES

Figure 5—8. Servicing Block Diagram

Figure 5—8. Servicing Block Diagram



WINDING RESISTANCES

SYMBOL	WINDINGS (PIN NO'S)	D C RES. (OHMS)
L101	SINGLE	48
L102	SINGLE	260
K101	1-8	150
K102	2-3	150
	3-5	20
D101	SINGLE	3600
D102		
T101	1-2	36.8
	3-4	50.9
T102	1-2	30.0
	3-4	43.0
T103	1-2	351
	3-4	54.8
T104	1-2	34.6
	3-4	6.8
	4-5	30.0
T105	1-2	2.7
	3-4	37
	4-5	37
	6-7	0.2
	8-9	0.2

NOTE:
1 CIRCUIT SHOW IN TRANSMIT CONDITION.
2 ALL RESISTORS 10 % 1/2 W UNLESS SPECIFIED OTHERWISE
3 VOLTAGE READINGS MEASURED WITH A 20,000 OHMS-PER-VOLT METER USING GROUND AS A COMMON TEST POINT.

Figure 5—9. System Schematic

Figure 5—9. System Schematic

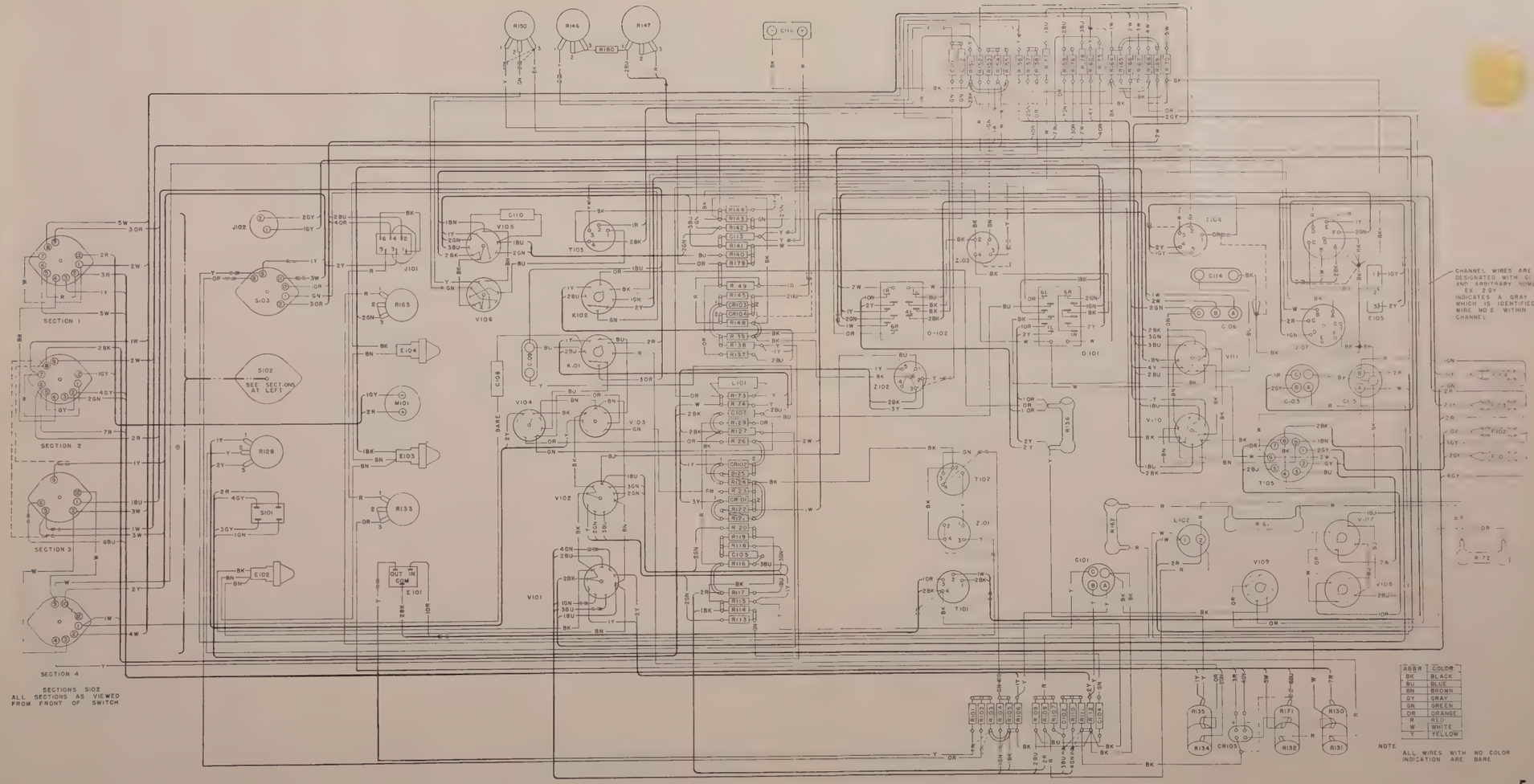


Figure 5—10. Wiring Diagram

Figure 5—10. Wiring Diagram

SECTION 6

PARTS LISTS

TABLE 6—1. WEIGHTS AND DIMENSIONS OF SPARE PARTS BOXES

EQUIPMENT SPARES						TENDER SPARES						STOCK SPARES					
SPARE PARTS BOX	OVERALL DIMENSIONS			VOLUME	WT.	SPARE PARTS BOX	OVERALL DIMENSIONS			VOLUME	WT.	SPARE PARTS BOX	OVERALL DIMENSIONS			VOLUME	WT.
	HT.	WIDTH	DEPTH				HT.	WIDTH	DEPTH				HT.	WIDTH	DEPTH		
1	6⅛	19⅛	16	1.08	49.0	1	9⅛	25⅛	16	2.12	87	1	11	21	18¾	2.5	82

TABLE 6—2. SHIPPING WEIGHTS AND DIMENSIONS OF SPARE PARTS BOXES

EQUIPMENT SPARES†							TENDER SPARES							STOCK SPARES						
SHIPPING BOX NUMBER	SPARE PARTS BOX	OVERALL DIMENSIONS			VOLUME	WT.	SHIPPING BOX NUMBER	SPARE PARTS BOX	OVERALL DIMENSIONS			VOLUME	WT.	SHIPPING BOX NUMBER	SPARE PARTS BOX	OVERALL DIMENSIONS			VOLUME	WT.
		HT.	WIDTH	DEPTH					HT.	WIDTH	DEPTH					HT.	WIDTH	DEPTH		
1	1	7¼	19½	16½	1.35	51.5	1	1	12	28½	18½	3.60	117	1	1	12¾	24¾	20½	3.70	117

† Packed with Basic Equipment

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

PARTS									SPARE PARTS			
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NUMBER	NAVY STANDARD STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR DWG AND PART NO.	ALL SYMBOL DESIG. INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	EQUIP.	TENDER	STOCK
A-101	MOUNT, vibration: sq mtg; 30-85 lbs; 3″ diam x 1½″ h w/3″ sq base; rubber cushion, plate mtd; steel sleeve, ⅜″ diam hole; four 0.255″ diam mtg holes on 2½″ sq ctrs	Isolates cabinet from shock		N16-M5061-45	CAYU: #C-2035	L-72704 -1	A-101 A-102 A-103 A-104	4	99	1	4	4
A-102	Same as A-101	Isolates cabinet from shock										
A-103	Same as A-101	Isolates cabinet from shock										
A-104	Same as A-101	Isolates cabinet from shock										
A-105	COVER, dust: assembly consisting of 1 rectangular alum can w/2 snapslide fasteners; 2″ x 3″ ID x 2½″ h x 0.020″ thk wall	For 0-101 and 0-102			CRL: Dwg # MM4684	H-72710 -1	A-105	1	100	0	0	1
C-101	CAPACITOR, fixed, electrolytic: three sections each 30 mfd -10% + 150%; 150 vdcw	Cathode by-pass for V-101, V-102	CE33F300J		CSF:	L-10186	C-101A C-101B C-101C	1	1	1	3	3
C-102	CAPACITOR, fixed, mica: 10,000 mmfd ±10%; 300 vdcw	Plate coupling for V-101	CM35B103K	N16-C10490-500	CMF:	L-10187	C-102 C-104 C-105 C-107 C-113	5	2	1	3	5
C-103	CAPACITOR, fixed, electrolytic: three sections each 20 mfd-10% +150%; 250 vdcw	Decoupling for V-101, V-106; Time delay for metering	CE33F200M		CSF:	L-10188	C-103A C-103B C-103C	1	3	1	3	3
C-104	Same as C-102	Plate coupling for V-101										
C-105	Same as C-102	Plate coupling for V-102										
C-106	CAPACITOR, fixed, paper: three sections each 0.1 mfd ± 15%; 600 vdcw	Grid charging capacitor for V-103, V-104; Time delay for V-110	CP69B5EF104L		CSL:	L-10189	C-106A C-106B C-106C	1	4	1	2	3

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

PARTS									SPARE PARTS			
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NUMBER	NAVY STANDARD STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR DWG AND PART NO.	ALL SYMBOL DESIG. INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	EQUIP.	TENDER	STOCK
C-107	Same as C-102	Keying filter for K-101										
C-108	CAPACITOR, fixed, paper: 0.1 mfd ±20%; 600 vdcw	Keying filter for K-101	CP29A1EF104M		CBV:	L-10163	C-108 C-110	2	5	1	3	5
C-109	CAPACITOR, fixed, paper: 0.5 mfd +20% —10%; 600 vdcw	Keying filter for K-101	CP69B1EF504V		CSL:	L-10190	C-109 C-114	2	6	1	3	5
C-110	Same as C-108	Oscillator coupling for V-105										
C-111	CAPACITOR, fixed, mica: 3600 mmfd ±2%; 500 vdcw	Frequency determining capacitor for V-105	CM35D362G		CMF:	L-10191	C-111 C-112	2	7	1	2	2
C-112	Same as C-111	Frequency determining capacitor for V-105										
C-113	Same as C-102	Plate coupling for V-105										
C-114	Same as C-109	Time delay for V-111										
C-115	CAPACITOR, fixed, electrolytic: two sections each 16 mfd —10%+150%; 400 vdcw	Filter capacitors for plate supply	CE32F160Q		CSF:	L-10192	C-115A C-115B	1	8	1	3	3
C-116	CAPACITOR, fixed, electrolytic: 20 mfd—10%+150%; 150 vdcw	Decoupling for V-105	CE63F200J		CSF:	L-10193	C-116	1	9	1	3	3
CR-101	CRYSTAL UNIT, rectifying: germanium, JAN-1N43	Mark tone rectifier for V-103	JAN-1N43		CW: 400-A	L-30307	CR-101 to CR-104	4	10	8	12	0
CR-102	Same as CR-101	Space tone rectifier for V-104										
CR-103	Same as CR-101	Frequency selector for V-105										

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

PARTS									SPARE PARTS			
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NUMBER	NAVY STANDARD STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR DWG AND PART NO.	ALL SYMBOL DESIG. INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	EQUIP.	TENDER	STOCK
CR-104	Same as CR-101	Frequency selector for V-105										
CR-105	RECTIFIER, metallic: copper oxide; input 0.1 v AC max, 1000 cps; output 0.06 v DC 2 milliamp max; oval $\frac{7}{16}$" x $\frac{5}{16}$" x $\frac{3}{8}$" d w/mtg foot; one hole mtg	Meter rectifier			CV: D-89367	L-30293	CR-105	1	11	1	1	2
E-101	ATTENUATOR, variable: bridged "T"; wire-wound; impedance 600 ohms ±5%; aluminum case $2\frac{1}{8}$" diam x $2\frac{3}{16}$" d; shaft $\frac{1}{4}$" diam x $\frac{15}{16}$" lg from case; linear attenuation change characteristic; 20 step attenuation at 2 db per step; 3 solder lug term; four #6-32 tapped mtg holes on $1\frac{1}{4}$" centers; silver plated contacts	Input circuit attenuator	(—637200)		CSM: 420-2B1	L-20416 -1	E-101	1	12	1	3	5
E-102	LAMP, incandescent: 6-8v, 0.25 amp; bulb T-$3\frac{1}{4}$ Clear; $1\frac{3}{16}$" lg overall; miniature bayonet base; C-2 filament; burn any position	POWER indicator	(—TB-11)	N16-L1220	CG: Mazda #44	L-60039 -1	E-102 E-103 E-104	3	13	6	12	18
E-103	Same as E-102	RECEIVE indicator										
E-104	Same as E-102	TRANSMIT indicator										
E-105	BOARD, terminal: 3 brass nickel pl screw term; term 15/32" between centers w/ solder lugs; movable link; laminated thermosetting plastic (PBE-P); 2" lg x 11/16" wd x $\frac{1}{2}$" thk overall; two 0.14" diam mtg holes on $1\frac{3}{4}$" centers	Output impedance changing strip for T-104			AE: #0731-RJ	L-50257	E-105	1		0	0	0

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

PARTS									SPARE PARTS			
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NUMBER	NAVY STANDARD STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR DWG AND PART NO.	ALL SYMBOL DESIG. INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	EQUIP.	TENDER	STOCK
E-106	SHIELD, tube: steel, cad pl; round, open top; friction mtd; 0.950″ ID x 1-15/16″ lg inside	for V-101			CPH: #5-411	L-72706	E-106 thru E-111	6	14	3	3	6
E-107	Same as E-106	for V-102										
E-108	Same as E-106	for V-105										
E-109	Same as E-106	for V-106										
E-110	Same as E-106	for V-110										
E-111	Same as E-106	for V-111										
E-112	SHIELD, tube: steel, cad pl; round, open top; friction mounted; 0.810″ ID x 2¼″ lg inside	for V-103			CEB: #8694	L-72707	E-112 E-113	2	15	1	1	2
E-113	Same as E-112	for V-104										
E-114	BOARD, terminal: 14 term (28 holes in 2 rows) ⅝″ c to c w/ barriers; molded phenolic	Cabinet term conn			CRL: Dwg # MM1678	W-50046	E-114	1	108	0	0	1
E-122	INSULATOR, bushing: molded phenolic; round, 0.390″ ID, ⅞″ OD, ¼″ thk overall	for TTY MONITOR jack			CRL: Dwg # MM4584	W-60079	E-122	1	16	1	1	2
E-123	WASHER, flat: type LE phenolic, wax dipped; round, 13/32″ ID, ⅞″ OD, 1/32″ thk	for TTY MONITOR jack			CRL: Dwg # MM4584	W-72772	E-123	1	17	1	1	2
F-101	FUSE, cartridge: 1.5 amp; 250 volts; opens in 1 hr on 135% overload and in 2 min on 200% overload, carries 110% overload indefinitely; one time; glass body; ferrule terminals; ¼″diam x 1¼″ lg overall	Power fuse	(—28032-1R5)	N16-F4250	CLF: #1041	L-60002 -1	F-101 F-102	2	18	40	80	200
F-102	Same as F-101	Power fuse										

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

PARTS									SPARE PARTS			
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NUMBER	NAVY STANDARD STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR DWG AND PART NO.	ALL SYMBOL DESIG. INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	EQUIP.	TENDER	STOCK
F-103	FUSE, cartridge: 3 amp; 250 volts; opens in 1 hr on 135% overload and in 2 min on 200% overload, carries 110% overload indefinitely; one time; glass body; ferrule terminals; 1/4" diam x 1 1/4" lg overall	Utility outlet fuse	(—28032-3)	N16-F5001	CLF: 1043	L-60007	F-103 F-104	2	19	20	40	100
F-104	Same as F-103	Utility outlet fuse										
H-101	CLAMP, tube: SS; 1 1/4" diam x 3/4" h; tension lock type	Clamp for V-107	(—49679)		CAIS: 926B	L-72709-1	H-101	2	20	1	1	1
H-102	Same as H-101	Clamp for V-108										
H-103	CLAMP, tube: SS; 1-5/32" diam x 3/4" h; tension lock type	Clamp for V-109	(—49496)		CAIS: 926A	L-72709	H-103	1	21	1	1	1
H-104	WRENCH: Allen set-screw; L-shaped; approx 2" lg w/ 11/16" ft; for #8 Allen-head set screw	for knobs			CAYT: code 564	L-70866	H-104	1	106	1	1	2
H-105	CAP and CHAIN: fits Amphenol #97-4085 receptacle; alum cap w/ beaded chain of brass nickel plated; 1 9/16" OD x 7/16" thk; coupling thd 1 3/8"-18, chain 4 5/8" lg	Cover for utility outlet (J-102)			CPH: 9760-22 (8C)	L-50270	H-105	1	103	1	1	2
H-106	CLAMP, cable: alum, black anodized finish; 1 3/16" diam x 1 1/8" d, fitting thd 1"-20; 2 bolts employed; accommodates 3/4" max OD cable	p/o W-101	AN3057-10(8C)		CPH:	L-50265	H-106	1	104	1	1	2
H-107	CLAMP, cable: alum, black anodized finish; 1-1/16" diam x 1 1/8" d; fitting thd 7/8"-20; 2 bolts employed; accommodates 5/8" max OD cable	p/o W-102	AN3057-8(8C)		CPH:	L-50266	H-107	1	105	1	1	2

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

PARTS									SPARE PARTS			
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NUMBER	NAVY STANDARD STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR DWG AND PART NO.	ALL SYMBOL DESIG. INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	EQUIP.	TENDER	STOCK
H-108	WASHER, flat: type LE phenolic, wax dipped; round, 5/32″ ID x 5/8″ OD x 1/16″ thk	for mtg precision resistors			CRL: Dwg # MM4582	W-72771	H-108	12	107	6	12	24
J-101	JACK, telephone: for 2 cond 0.25″ diam plug; 3-3/32″ lg x 15/16″ w x 1 1/8″ h (all dim excluding mtg bushing and washers); J4-1C contact arrangement; includes one 5/8″ OD washer and one hex nut 1/2″ w across flats; mtg bushing 3/8″-32 thd	TTY MONITOR jack	(—49810)		CMA:	L-50249	J-101	1	22	1	1	2
J-102	CONNECTOR, female contact: 2 rectangular parallel contacts; straight; 1 5/8″ sq x 27/32″ deep; 15 amp at 115V; aluminum body, black anodized, melamine insert; for 1/8″ mtg insert; for 1/8″ mtg holes on 1 1/4″ x 1 1/4″ mtg /c	Utility outlet	(—49435)	N16-R2833	CPH: 97-4085	L-50250	J-102	1	23	1	1	2
J-103	CONNECTOR, female contact: octal socket; one piece under chassis mtg; two 5/32″ diam holes on 1 1/2″ mtg/c; round melamine body, 1 1/8″ diam x 1/2″ h excluding term; phosphor bronze silver plated contacts	Socket for K-101	(—49557-A)	N16-S4655-14	CMG: T-9663	L-50244	J-103 J-104 J-105	3	24	2	3	6
J-104	Same as J-103	Socket for K-102										
J-105	Same as J-103	Socket for spare polar relay										
J-107	CONNECTOR, male contact: 8 round male contacts; chassis mtg	Receptacle for W-101	AN-3102-18-8PH (8C)		CPH:	L-50261	J-107	1	25	1	1	2

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

PARTS									SPARE PARTS			
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NUMBER	NAVY STANDARD STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR DWG AND PART NO.	ALL SYMBOL DESIG. INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	EQUIP.	TENDER	STOCK
J-108	CONNECTOR, female contact: 7 round female contacts; chassis mtg	Receptacle for W-102	AN3102-16S-1SH (8C)		CPH:	L-50262	J-108	1	26	1	1	2
J-109	CONNECTOR, female contact: 8 round female contacts; black anodized aluminum	p/o W-101	AN3108-18-8SH (8C)		CPH:	L-50268	J-109	1	101	1	1	2
J-110	CONNECTOR, male contact: 7 round male contacts; black anodized aluminum	p/o W-102	AN3108-16S-1PH (8C)		CPH:	L-50269	J-110	1	102	1	1	2
K-101	RELAY, polar: cont arrgt SPDT; cont rating 270 vDC, 0.2 amp; 3/32″ diam tungsten cont; three windings, 9 vDC, 0.060 amp, 150 ohms ea coils one and two, coil three 20 ohms, inductive, polarized; octal base cont; 2-29/64″ lg x 1 $\frac{9}{16}$″ sq overall excluding term; octal socket mtg; fast acting; hermetically sealed	Receive relay	(—291725)		CSI: 7JOZ	L-40207	K-101 K-102	2	27	1	3	5
K-102	Same as K-101	Send relay										
L-101	COIL: choke; 4-pie universal wound; unshielded; 2.5 mh at 1 mc, 100 ma, 48 ohms 5/8″ diam x 1-11/16″ lg overall excluding leads; isolantite form; axial leads ea 3½″ lg; hermetically sealed	p/o keying filter for K-101	(—472403)		CSM: Type 219	L-30306	L-101	1	28	1	2	3
L-102	REACTOR: filter choke; 8 hy, 80 ma; 250 ohm DC resistance; 1000 volts RMS test; hermetically sealed metal case; cylindrical case 2⅛″ diam x 2⅞″ lg w/2 $\frac{3}{16}$″ sq mtg flange; four 0.170″ mtg holes on 1-13/16″ sq centers, 2 solder lug terminals on bottom	for plate supply	(—304773)		CUT: C-9854	L-30337	L-102	1	29	1	2	3

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

PARTS									SPARE PARTS			
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NUMBER	NAVY STANDARD STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR DWG AND PART NO.	ALL SYMBOL DESIG. INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	EQUIP.	TENDER	STOCK
M-101	METER, arbitrary scale: DC; zero center, 1 ma full scale deflection left or right, scale 100-0-100 and —10 dbm to +5 dbm; round plastic flush mtg case; 3½″ diam flange x 2¾″ diam body x 1½″ d behind flange; accuracy ± 2%; calibrated for non-magnetic panel; 50 scale divisions, black numerals on white background; self contained; three mtg holes, 5/32″ diam on 1.58″ radius spaced 120° apart on flange; 2 stud term ¼″-28 x ¾″ lg spaced 1¼″ c to c	Circuit measurement	MR35W103SPEC		CAVK: #431	L-60075	M-101	1	30	0	0	1
N-101	PLATE, identification: SS; 3″ lg x 2″ wd x 1/16″ thk inscribed "AN/SGC-1 Radio Teletype Terminal Set"; engraved 0.003″ d black background; four ⅛″ diam mtg holes on 2¾″ x 1¾″ mtg/c; not individually packed	Nameplate			AH:	W-72705	N-101	1		0	0	0
O-101	RELAY, armature: cont arrangement 1A2B2C; cont rating 4 amp; 0.075″ diam dual palladium cont; single winding 100 v DC 3600 ohm inductive; solder lug term on coil and contacts; 2¼″ lg x 1⅛″ wd x 1½″ h overall; two 5/32″ mtg holes, ¾″ c to c; fast acting; impregnated for tropical use	Receive control relay	(—291726)		CRY: A-38706 Type J	L-40209	O-101	1	31	1	2	3
O-102	RELAY, armature: cont arrangement 5A; cont rating 4 amp; 0.075″ diam dual palladium contacts; single winding 100 v DC, 3600 ohm, inductive; solder lug	Transmit control relay	(—291724)		CRY: B-38706 Type J	L-40210	O-102	1	32	1	2	3

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

PARTS									SPARE PARTS			
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O-102 *(Contd)*	term on coil and contacts; 2¼" lg x 1⅛" wd x 1½" h overall; two #6-32 tapped mtg holes, ¾" c to c; fast acting, impregnated for tropical use											
O-103A	CLIP: fuse; phosphor bronze silver pl; 5/16" lg x 11/32" wd x 29/64" h overall; 20 amp 250 v cap; 0.131" mtg hole; has stop "ears"	for F-101	(—28001)	N16-C13946-19	CLF: 102001	L-70806 -1	O-103A B O-104A B O-105A B O-106A B O-107A B O-108A B	12	33	2	3	12
O-103B	Same as O-103A	for F-101										
O-104A	" " "	for F-102										
O-104B	" " "	for F-102										
O-105A	" " "	for F-103										
O-105B	" " "	for F-103										
O-106A	" " "	for F-104										
O-106B	" " "	for F-104										
O-107A	" " "	for spare										
O-107B	" " "	for spare										
O-108A	" " "	for spare										
O-108B	" " "	for spare										
R-101	RESISTOR, fixed; comp; 200 ohms ±5%; ½ w; axial leads	p/o input pad	RC20BF201J	N16-R10401	CBZ: EB-2015	L-20419	R-101 R-102 R-153 R-154	4	34	2	12	20
R-102	Same as R-101	p/o input pad										
R-103	RESISTOR, fixed: comp; 820 ohms ±5%; ½ w; axial leads	p/o input pad	RC20BF821J	N16-R10488-100	CBZ: EB-8215	L-20480 -1	R-103 R-139 R-155	3	35	2	9	15

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

PARTS									SPARE PARTS			
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R-104	RESISTOR, fixed: comp; 470,000 ohms ±10%; ½ w; axial leads	Grid series, V-101A	RC20BF474K	N16-R10899-100	CBZ: EB-4741	L-20422	R-104 R-110 R-113 R-118 R-169	5	36	3	15	25
R-105	RESISTOR, fixed: comp; 100,000 ohms ±10%; ½ w; axial leads	Grid leak, V-101A	RC20BF104K	N16-R10803-100	CBZ: EB-1041	L-20421	R-105 R-129 R-159 R-164 R-176	5	37	3	15	25
R-106	RESISTOR, fixed: comp; 15,000 ohms ±10%; ½ w; axial leads	Cathode bias, V-101A	RC20BF153K	N16-R10683-100	CBZ: EB-1531	L-20425	R-106 R-112 R-115 R-145	4	38	2	12	20
R-107	RESISTOR, fixed: comp; 220,000 ohms ±10%; ½ w; axial leads	Plate load, V-101A	RC20BF224K	N16-R10851-100	CBZ: EB-2241	L-20424	R-107 R-109 R-116	3	39	2	9	15
R-108	RESISTOR, fixed: comp; 22,000 ohms ±10%; ½ w; axial leads	Plate decoupler, V-101	RC20BF223K	N16-R10707-100	CBZ: EB-2231	L-20423	R-108 R-140 R-141	3	40	2	9	15
R-109	Same as R-107	Plate load, V-101B										
R-110	Same as R-104	Grid series, V-101B										
R-111	RESISTOR, fixed: comp; 330,000 ohms ±10%; ½ w; axial leads	Grid leak, V-101B	RC20BF334K	N16-R10875-100	CBZ: EB-3341	L-20426	R-111 R-114 R-119	3	41	2	9	15
R-112	Same as R-106	Cathode bias, V-101B										
R-113	Same as R-104	Grid series, V-102A										
R-114	Same as R-111	Grid leak, V-102A										
R-115	Same as R-106	Cathode bias, V-102A										
R-116	Same as R-107	Plate load, V-102A										

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

PARTS									SPARE PARTS			
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NUMBER	NAVY STANDARD STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR DWG AND PART NO.	ALL SYMBOL DESIG. INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	EQUIP.	TENDER	STOCK
R-117	RESISTOR, fixed: comp; 39,000 ohms ±10%; 1 w; axial leads	Plate load, V-102B	RC30BF393K	N16-R11743-100	CBZ: GB-3931	L-20495	R-117	1	42	1	3	5
R-118	Same as R-104	Grid series, V-102B										
R-119	Same as R-111	Grid leak, V-102B										
R-120	RESISTOR, fixed: comp; 680 ohms ±10%; ½ w; axial leads	Cathode bias, V-102B	RC20BF681K	N16-R10479-100	CBZ: EB-6811	L-20496	R-120 R-180	2	43	1	6	10
R-121	RESISTOR, fixed: comp; 10,000 ohms ±10%; ½ w; axial leads	Load for Z-102	RC20BF103K	N16-R10659-100	CBZ: EB-1031	L-20455	R-121 R-124 R-179	3	44	2	9	15
R-122	RESISTOR, fixed; comp; 56,000 ohms ±5%; ½ w; axial leads	Grid leak, V-103	RC20BF563J	N16-R10764-100	CBZ: EB-5635	L-20452	R-122 R-125 R-156	3	45	2	9	15
R-123	RESISTOR, fixed: comp; 1 meg-ohm ±5%; ½ w; axial leads	Grid series, V-103	RC20BF105J	N16-R10944-100	CBZ: EB-1055	L-20479	R-123 R-126	2	46	1	6	10
R-124	Same as R-121	Load for Z-102										
R-125	Same as R-122	Grid leak, V-104										
R-126	Same as R-123	Grid series, V-104										
R-127	RESISTOR, fixed: comp; 470 ohms ±10%; 2 w; axial leads	p/o cathode bias, V-103 and V-104	RC40BF471K	N16-R12297-10	CBZ: HB-4711	L-20497	R-127	1	47	1	3	5
R-128	RESISTOR, variable: WW; 500 ohms ±10%; 2 w; linear taper	p/o cathode bias, V-103 and V-104	RA20A2FD501AK		CTC:	L-20498	R-128	1	48	1	3	5
R-129	Same as R-105	Screen resistor, V-103 and V-104										

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

PARTS									SPARE PARTS			
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R-130	RESISTOR, fixed; WW; 10 ohms ±1%; 1/3 w	Metering, V-103 plate	RB11B10R00F		CSM:	L-20429	R-130 R-131 R-135	3	49	2	9	15
R-131	Same as R-130	Metering, V-104 plate										
R-132	RESISTOR, fixed: WW; 355 ohms ±1%; 1/3 w	Metering, PLATE CURR	RB11B355R0F		CSM:	L-20499	R-132	1	50	1	3	5
R-133	RESISTOR, variable: WW; 3500 ohms ±10%; 25 w	LOOP CURR adj., in tty loop	RP101FD352KK		CIR:	L-20418	R-133	1	51	1	3	5
R-134	RESISTOR, fixed: WW; 1000 ohms ±1%; 1/3 w	Meter series res, in tty loop	RB11B1000RF		CSM:	L-20500	R-134	1	52	1	3	5
R-135	Same as R-130	Metering, tty loop										
R-136	RESISTOR, fixed: WW; 1200 ohms ±5%; 8 w	Standby resistor, in tty loop	RW31F122		CAO:	L-20438	R-136	1	53	1	3	5
R-137	RESISTOR, fixed: comp; 4700 ohms ±10%; 1/2 w; axial leads	Armature series res., K-102	RC20BF472K	N16-R10611-100	CBZ: EB-4721	L-20494	R-137 R-168 R-170	3	54	2	9	15
R-138	RESISTOR, fixed: comp; 15,000 ohms ±10%; 2 w; axial leads	p/o keying voltage divider, K-102	RC40BF153K	N16-R12369-10	CBZ: HB-1531	L-20501	R-138	1	55	1	3	5
R-139	Same as R-103	p/o keying voltage divider, K-102										
R-140	Same as R-108	Plate load, V-105A										
R-141	Same as R-108	Plate load, V-105B										
R-142	RESISTOR, fixed: comp; 1 meg-ohm ±5%; 1 w; axial leads	p/o freq. network, V-105	RC30BF105J	N16-R11944-100	CBZ: GB-1055	L-20517	R-142	1	56	1	3	5
R-143	RESISTOR, fixed: comp; 47,-000 ohms ±10%; 1/2 w; axial leads	Grid leak, V-105B	RC20BF473K	N16-R10755-100	CBZ: EB-4731	L-20481 -1	R-143 R-165	2	57	1	6	10

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

PARTS									SPARE PARTS			
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NUMBER	NAVY STANDARD STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR DWG AND PART NO.	ALL SYMBOL DESIG. INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	EQUIP.	TENDER	STOCK
R-144	RESISTOR, fixed: comp; 820 ohms ±10%; ½ w; axial leads	Cathode bias, V-105	RC20BF821K	N16-R10491-100	CBZ: EB-8201	L-20480	R-144	1	58	1	3	5
R-145	Same as R-106	Shunt, CR-103										
R-146	RESISTOR, variable: WW; 1500 ohms ±10%; 2 w; linear taper	MARK FREQ ADJ, for V-105	RA20A1SA152AK		CTC:	L-20476	R-146	1	59	1	3	5
R-147	RESISTOR, variable: WW; 15,000 ohms ±10%; 3 w; linear taper	SPACE FREQ ADJ, for V-105	RA25A1SA153AK		CTC:	L-20478	R-147	1	60	1	3	5
R-148	RESISTOR, fixed: comp; 390 ohms ±5%; ½ w; axial leads	p/o freq network, V-105	RC20BF391J	N16-R10440-100	CBZ: EB-3915	L-20433 -1	R-148 R-173	2	61	1	6	10
R-149	RESISTOR, fixed: comp; 22,000 ohms ±10%; 2 w; axial leads	p/o bias net., CR-104	RC40BF223K	N16-R12377-10	CBZ: HB-2231	L-20337	R-149	1	62	1	3	5
R-150	RESISTOR, variable: composition; 500,000 ohms ±10%; ½ w; three solder lugs; enclosed metal case 1¼″ diam x $\frac{9}{16}$″ d; slotted shaft ½″ lg from mtg surface; log taper; insulated cont arm without off position; normal torque; bushing ⅜″ —32 x ⅜″ lg non-turn device located on 17/32″ radius at 9 o'clock	SEND LEVEL ADJ, grid, V-106	(—632395-K10)		CBZ:	L-20445	R-150	1	63	1	3	5
R-151	RESISTOR, fixed: comp; 1000 ohms ±10%; ½ w; axial leads	Cathode bias, V-106	RC20BF102K	N16-R10505-100	CBZ: EB-1021	L-20444	R-151	1	64	1	3	5
R-152	RESISTOR, fixed: comp; 2200 ohms ±10%; ½ w; axial leads	Plate decoupler, V-106	RC20BF222K	N16-R10563-100	CBZ: EB-2221	L-20446	R-152	1	65	1	3	5

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

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R-153	Same as R-101	p/o output pad										
R-154	Same as R-101	p/o output pad										
R-155	Same as R-103	p/o output pad										
R-156	Same as R-122	Cathode series, V-110A										
R-157	RESISTOR, fixed: comp; 10 megohms ±10%; ½ w; axial leads	p/o time delay net, V-110A	RC20BF106K		CBZ: EB-1061	L-20456	R-157 R-158	2	66	1	6	10
R-158	Same as R-157	p/o time delay net, V-110A										
R-159	Same as R-105	Grid series, V-111B										
R-160	RESISTOR, fixed: comp; 3.3 megohms ±10%; ½ w; axial leads	Cathode series, V-111A	RC20BF335K		CBZ: EB-3351	L-20364	R-160	1	67	1	3	5
R-161	RESISTOR, fixed: WW; 5,000 ohms ±5%; 24 w	p/o space wndg bleeder, K-102	RW33F502	N16-R17741-100	CAO:	L-20449	R-161	1	68	1	3	5
R-162	RESISTOR, fixed: WW; 800 ohms ±5%; 8 w	p/o space wndg bleeder, K-102	RW31F801	N16-R17023-100	CAO:	L-20462	R-162	1	69	1	3	5
R-163	RESISTOR, variable: WW; 5,000 ohms ±10%; 25 w	p/o space wndg bleeder, K-102	RP101FD502KK		CIR:	L-20459	R-163	1	70	1	3	5
R-164	Same as R-105	p/o ref volt net, S-102										
R-165	Same as R-143	p/o ref volt net, S-102										
R-166	RESISTOR, fixed: comp; 3300 ohms ±10%; ½ w; axial leads	Meter series resistor for bias meas	RC20BF332K	N16-R10587-100	CBZ: EB-3321	L-20454	R-166	1	71	1	3	5

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

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R-167	RESISTOR, fixed: comp; 33,000 ohms ±10%; ½ w; axial leads	Time delay, bias meas	RC20BF333K	N16-R10731-100	CBZ: EB-3331	L-20473	R-167	1	72	1	3	5
R-168	Same as R-137	Balance resistor, REC BIAS										
R-169	Same as R-104	Calib. resistor, REC BIAS										
R-170	Same as R-137	Balance resistor, REC BIAS										
R-171	RESISTOR, fixed: WW; 850 ohms ±1%; ⅓ w	Series, CR-105	RB11B850R0F		CSM:	L-20453	R-171	1	73	1	3	5
R-172	RESISTOR, fixed: WW; 3100 ohms ±5%; 16 w	Plate series, V-109	RW32F312		CAO:	L-20503	R-172	1	74	1	3	5
R-173	Same as R-148	p/o keying filter, K-101										
R-174	RESISTOR, fixed: comp; 1500 ohms ±10%; ½ w; axial leads	p/o keying filter, K-101	RC20BF152K	N16-R10529-100	CBZ: EB-1521	L-20432	R-174	1	75	1	3	5
R-175	RESISTOR, fixed: comp; 200 ohms ±5%; 2 w; axial leads	TTY MONITOR jack	RC40BF201J	N16-R10399-100	CBZ: HB-2015	L-20435	R-175	1	76	1	3	5
R-176	Same as R-105	Time delay, V-111A										
R-177	RESISTOR, fixed: comp; 3300 ohms ±10%; 2 w; axial leads	Plate series, V-111B	RC40BF332K		CBZ: HB-3321	L-20487	R-177 R-178	2	77	1	6	10
R-178	Same as R-177	Plate series, V-110B										
R-179	Same as R-121	Plate decoupler, V-105										
R-180	Same as R-120	p/o freq network, V-105										

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S-101	SWITCH, toggle: DPST; 5 amps 125 vAC	Power	ST23K		CHH:	L-40203	S-101	1	78	1	1	1
S-102	SWITCH, rotary: complex contact layout; 7 position, 4 deck; phosphor bronze cont; ceramic body; 2″ diam x 2⅛″ d to mtg surface; non-shorting; locking action; solder lug term; single hole mtg, bushing ⅜″-32	Metering			CMA:	L-40211	S-102	1	79	1	1	1
S-103	SWITCH, rotary: complex contact layout; 4 position, single deck; phosphor bronze cont; ceramic body; 2″ diam x 1″ d to mtg surface; non-shorting; locking action; solder lug term; single hole mtg; bushing ⅜″-32	Control of circuits			CMA:	L-40212	S-103	1	80	1	1	1
T-101	TRANSFORMER, AF: line type; primary 600 ohms impedance, secondary 600 ohms impedance; upright shielded case, nickel alloy core; 2 5/16″ lg x 1½″ wd x 1 13/16″ h overall excluding term; max audio level + 10 dbm; turns ratio of pri to secd 1:1; freq response 400 to 800 cps 0.5 dbm; electrostatic shielding between pri and secd connected to case; four stud term in molded phenolic base; two 5/16″ diam mtg holes on 1-15/16″ ctrs; hermetically sealed	Input line isolation	(—304774)		CBNC: 10528	L-30285	T-101	1	81	1	2	3
T-102	TRANSFORMER, AF: input type; primary 600 ohms impedance, secondary 100,000 ohms impedance; external loading; upright shielded case, nickel alloy core; 2 5/16″ lg x 1½″ wd x 1 13/16″ h overall excluding term;	Input grid matching	(—304775)		CBNC: 3041	L-30289	T-102	1	82	1	2	3

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PARTS									SPARE PARTS			
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T-102 *(Cont'd)*	max audio level + 10 dbm; turns ratio of pri to secd 1:12.9; freq response 400 to 800 cps 0.5 dbm; electrostatic shielding between pri and secd connected to case; four stud term in molded phenolic base; two $\frac{3}{16}$" diam mtg holes on 1-15/16" ctrs; hermetically sealed											
T-103	TRANSFORMER, AF: plate coupling type; primary 8000 ohms impedance, secondary 600 ohms impedance; max DC current in pri winding 20 ma; upright shielded case, nickel alloy core; $2\frac{5}{16}$" lg x $1\frac{1}{2}$" wd x $2\frac{3}{16}$" h overall excluding term; max audio level +30 dbm; turns ratio of primary to secondary 3.65:1; freq response 400 to 800 cps 0.5 dbm; electrostatic shielding between pri and secd connected to case; 4 stud term in molded phenolic base; two $\frac{3}{16}$" diam mtg holes on 1-15/16" ctrs; hermetically sealed	Output plate matching	(—304777)		CBNC: 1664	L-30288-1	T-103	1	83	1	2	3
T-104	TRANSFORMER, AF: line type; primary 600 ohms impedance, secondary 600 ohms impedance, tapped at 50 ohms impedance, max DC cur in 50 ohm wnd 100 ma; upright shielded case nickel alloy core; $2\frac{5}{16}$" lg x $1\frac{1}{2}$" wd x $1\frac{13}{16}$" h overall excluding term; max audio level +1.0 dbm; turns ration of pri to secd to 50 ohm tap 3.46:1;	Output line isolation	(—304776)		CBNC: 10529	L-30286	T-104	1	84	1	2	3

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

PARTS									SPARE PARTS			
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NUMBER	NAVY STANDARD STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR DWG AND PART NO.	ALL SYMBOL DESIG. INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	EQUIP.	TENDER	STOCK
T-104 *(Cont'd)*	freq response 400 to 800 cps 0.5 dbm; electrostatic shielding between pri and secd connected to case; 5 stud term in molded phenolic base; two $\frac{3}{16}$" diam mtg holes on 1-15/16" ctrs; hermetically sealed											
T-105	TRANSFORMER, power: filament and plate type; input 115 v 10%, 50/60 cyc, single ph; three output wdg; *secd #1:* 500 v at 0.150 amp CT, *secd #2:* 5 v at 4 amp, *secd #3:* 6.3 v at 3.5 amp; hermetically sealed metal case; case w/o term $4\frac{7}{16}$" sq x $3\frac{5}{8}$" h; 9 solder lug term on bottom of case; four $\frac{8}{16}$" diam mtg holes on 3-9/16" ctrs	Power	(—304772)		CUT: C-9853	L-30338	T-105	1	85	1	2	3
V-101	TUBE, electron: JAN-12AU7; miniature twin triode	1st and 2nd amp-lim.	JAN-12AU7		CRC:		V-101 V-102 V-105 V-106 V-110 V-111	6	86	18	36	0
V-102	Same as V-101	3rd and 4th amp-lim.										
V-103	TUBE, electron: JAN-6AQ5; beam power amplifier	Mark dc amplifier	JAN-6AQ5		CRC:		V-103 V-104	2	87	6	12	0
V-104	Same as V-103	Space dc amplifier										
V-105	Same as V-101	Oscillator										
V-106	Same as V-101	Tone amplifier										

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

PARTS									SPARE PARTS			
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NUMBER	NAVY STANDARD STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR DWG AND PART NO.	ALL SYMBOL DESIG. INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	EQUIP.	TENDER	STOCK
V-107	TUBE, electron; JAN-5Y3GT; full-wave high-vacuum rectifier	Plate rectifier	JAN-5Y3GT		CRC:		V-107 V-108	2	88	4	6	0
V-108	Same as V-107	Plate rectifier										
V-109	TUBE, electron: JAN-OC3/VR 105 voltage regulator	Voltage regulator	JAN-OC3/VR105		CRC:		V-109	1	89	2	3	0
W-101	CABLE ASSEMBLY, power: uses Navy type MHFF-7 cable; four ft lg excluding terminations; Army-Navy connector AN 3108-18-8SH(8C) on one end, Patton-MacGuyer #1841-L-28 (Spec) spade lugs on other end	Power and teletype			CRL: Dwg #AL4479	S-1011-CAB	W-101	1				
W-102	CABLE ASSEMBLY, power: uses Navy type MCOS-6 cable; four ft lg, excluding terminations; Army-Navy connector AN3108-16S-1PH(8C) on one end, Patton-MacGuyer #1841-L-28 (Spec) spade lugs on other end	Tone and control circuits			CRL: Dwg #AL4479	S-1012-CAB	W-102	1				
XE-102	LIGHT, indicator: with lens; ½" diam amber smooth inside frosted lens; for miniature bayonet base, T-3¼" bulb; 6-8 v, ½ amp; black	POWER lamp socket			CAYZ: 982210-131	L-60078	XE-102	1	90	1	1	1
XE-103	Same as XE-102, except red jewel	RECEIVE lamp socket			CAYZ: 982210-131	L-60076	XE-103	1	91	1	1	1
XE-104	Same as XE-103, except green jewel	TRANSMIT lamp socket			CAYZ: 982210-131	L-60077	XE-104	1	92	1	1	1

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

PARTS									SPARE PARTS			
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NUMBER	NAVY STANDARD STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR DWG AND PART NO.	ALL SYMBOL DESIG. INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	EQUIP.	TENDER	STOCK
XH-104	HOLDER, tool: spring type wire clip; no dimension of this item exceeds one inch; single mtg hole for #8-32 screw	Allen wrench holder			AD: #2	L-50256	XH-104	1	93	0	0	1
XV-101	SOCKET, tube: 9-contact miniature; above chassis base mtg; two 1/8" diam mtg holes on 1 1/8" mtg/c, 3/4" chassis cutout required; round mica-filled phenolic body with shock shield 1 1/8" wd x 1 1/2" lg x 7/8" h overall excluding term; with 3/16" ID center shield	for V-101	(—491853)		CPH: 59-403	L-50245	XV-101 XV-102 XV-105 XV-106 XV-110 XV-111	6	94	3	3	6
XV-102	Same as XV-101	for V-102										
XV-103	SOCKET, tube: 7-contact miniature; above chassis base mtg; two 1/8" diam mtg holes on 7/8" mtg/c, 5/8" chassis cutout required; round mica-filled phenolic body with shock shield 0.900" wd x 1 1/8" lg x 1" h overall excluding term; with 0.095" ID center shield	for V-103	SO10M		CEB: #7670	L-50246	XV-103 XV-104	2	95	1	1	2
XV-104	Same as XV-103	for V-104										
XV-105	Same as XV-101	for V-105										
XV-106	Same as XV-101	for V-106										
XV-107	SOCKET, tube: octal; one piece under-chassis mtg; two 5/32" diam holes on 1 1/2" mtg/c; round melamine body 1 1/8" diam x 1/2" h excluding term; phos bz silver pltd contacts	for V-107	(—49557-A)	N16-S4655-14	CMG: T-9663	L-50244	XV-107 XV-108 XV-109	3	96	2	2	3

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

PARTS									SPARE PARTS			
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NUMBER	NAVY STANDARD STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR DWG AND PART NO.	ALL SYMBOL DESIG. INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	EQUIP.	TENDER	STOCK
XV-108	Same as XV-107	for V-108										
XV-109	Same as XV-107	for V-109										
XV-110	Same as XV-101	for V-110										
XV-111	Same as XV-101	for V-111										
Z-101	FILTER, band pass: 565 cps peak, 400 to 800 cps band width; 2¾″ sq x 3⅛″ h overall excluding term; 600 ohm output impedance; rectangular metal case; four #8-32 tapped holes ⅜″ d on 2¼″ sq ctrs; four solder stud term on bottom; hermetically sealed	Input filter	(—53550)		CBIS: S-2322	L-30284 -1	Z-101 Z-103	2	97	2	4	6
Z-102	FILTER, band pass, dual: section 1—500 cps peak, 425 to 575 cps band width, section 2—700 cps peak 625 to 775 cps band width (complementary design); 2¾″ sq x 3⅛″ h overall excluding term; 10,000 ohm output impedance ea section; rectangular metal case; four #8-32 tapped holes ⅜″ d on 2¼″ sq ctrs; six solder stud term on bottom, hermetically sealed	Frequency discriminator	(—53551)		CBIS: S-2244	L-30283 -2	Z-102	1	98	1	2	3
Z-103	Same as Z-101	Output filter										

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

PARTS									SPARE PARTS			
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NUMBER	NAVY STANDARD STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR DWG AND PART NO.	ALL SYMBOL DESIG. INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	EQUIP.	TENDER	STOCK
	SPECIAL HARDWARE											
	CLAMP: electrolytic condenser fastener; steel, cad pl; one bolt employed; 1 3/8" diam x 3/4" h; two 3/16" holes on 1-13/16" mtg-/c	Secures C-101, C-103, and C-115 to chassis			CMA: VR-3 (1-3/8")	L-73020		3	109	0	0	3
	CLAMP ASSEMBLY: polar relay hold down; phos bz, cad pl; one thumb screw employed; 2 3/4" lg x 1 1/2" wd x 7/16" h overall x 0.064" thk; one 1/4" diam mtg hole	For K-101, K-102			CRL: Dwg # MM4587	W-72770 -4		1	110	0	0	1
	CLAMP ASSEMBLY: hold down clamp for spare polar relay; phos bz, cad pl; one thumb screw employed; 1 3/4" lg x 1 1/2" wd x 7/16" h overall x 0.064" thk; one 1/4" diam mtg hole	For spare polar relay			CRL: Dwg # MM4587	W-72770 -5		1	111	0	0	1
	CLIP: hold down; stainless steel; 29/32" lg x 1/2" wd x 19/32" h overall x 0.067" thk sheet	Secures L-101 to terminal board			CRL: Dwg # MM4587	W-72767		1	112	0	0	1
	COVER: spring type, for jack; no dimension of this item is greater than one inch; 3/8" diam mtg hole to fit over jack bushing on front panel	For J-101			AC: A-23559	L-73021		1	113	0	0	1
	GROMMET: rubber; fits 5/16" diam hole; 3/16" ID x 7/16" OD x 7/32" thk x 1/16" thk of groove	Insulates leads to O-101 & O-102			AA: #GB-215	L-72974		4	114	0	0	4
	GROMMET: rubber; fits 5/8" diam hole; 1/2" ID x 13/16" OD x 9/32" thk x 1/16" thk of groove	Cable grommet, side			AA: #GB-230	L-72975		1	115	0	0	1

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

PARTS									SPARE PARTS			
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NUMBER	NAVY STANDARD STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR DWG AND PART NO.	ALL SYMBOL DESIG. INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	EQUIP.	TENDER	STOCK
	SPECIAL HARDWARE (Continued)											
	GROMMET: rubber; fits 13/16″ diam hole; 11/16″ ID x 1-1/16″ OD x 1/4″ thk x 1/16″ thk of groove	Cable grommet, front			AA: #GB-2301	L-72976		1	116	0	0	1
	HANDLE: chassis; stainless steel; 5 3/8″ lg x 2-1/16″ h x 3/8″ diam rod; two #10-32 tapped holes on 5″ mtg ctrs	On front panel			CRL: Dwg # MM4586	W-72754		2	117	0	0	2
	KNOB, dial: round, black plastic molded; for 1/4″ diam shaft; double #8-32 set screw; arrow marking; skirt 1 1/2″ diam x 1/4″ thk; dial knob 1-11/16″ lg x 9/16″ wd x 7/8″ h overall including thk of skirt; brass insert; depth of shaft hole 3/8″	For panel controls			CRL: Dwg # MM4454	W-72655		6	118	0	0	6
	LOCKWASHER: split; phos bz; round 3/16″ ID x 17/64″ OD x 3/64″ thk; OD special to equal that of a #8-32 Fil H Mach Screw	p/o E-114			CRL:	L-70089 -1		13	119	0	0	13
	NUT, bar: brass, nickel pl; two #8-32 holes, 7/32″ c to c; 3/32″ thk x 3/4″ lg x 3/8″ wd	Used w/ term bd (E-114)			CRL: Dwg # MS-1279	W-70275		14	120	0	0	14
	PIN, dowel, assembly: consists of 1 PIN, dowel and 1 BRACKET, dowel pin; stainless steel; 4-7/16″ lg x 1 3/8″ wd x 2-13/16″ h overall x 0.075″ thk sheet	Alignment of chassis			CRL: Dwg # MM4685	W-73037		2	121	0	0	2
	POST, binding: screw type; 3/8″ diam x 2 5/8″ lg; #8-32 tapped hole 5/8″ d on one end, #12-24 tapped hole 7/8″ d on other end; stainless steel	Supports polar relay clamp			CRL: Dwg # MM4586	W-72758		2	122	0	0	2

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

PARTS									SPARE PARTS			
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NUMBER	NAVY STANDARD STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR DWG AND PART NO.	ALL SYMBOL DESIG. INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	EQUIP.	TENDER	STOCK
	SPECIAL HARDWARE (Continued)											
	POST, supporting: stainless steel; 1-41/64″ lg x ¼″ diam; #8-32 tapped hole ½″ d on one end	Supports telephone relay dust cover			CRL: Dwg # MM4626	W-72977		2	123	0	0	2
	ROLLER: brass, nickel pl 0.0005″ thk; no dim of this item is greater than one inch	Supports chassis-tip-up runners			CRL: Dwg # MM4583	W-72756		8	124	0	0	8
	SCREW, set: Allen drive; #8-32 x ⅛″ lg; copper and cad pl	For dial knobs			CAYT:	L-70886 -1		6	125	0	0	6
	SCREW, set: Allen drive; #8-32 x ⅜″ lg; copper and cad pl	For dial knobs			CAYT:	L-70886 -4		6	126	0	0	6
	SCREW, captive: slot drive; knurled thumb hd; stainless steel; #12-24 and 5/16-24 thds; 1″ lg under head; #12-24 thd 27/64″ lg, 5/16-24 thd 5/64″ lg; ⅝″ diam x ½″ lg head slotted; the 5/16-24 threaded section fits into a retainer on the front panel of the equip which makes the screw a captive screw	Fastens front panel to cabinet			CRL: Dwg # MM4449	W-72762 -1		4	127	0	0	4
	SCREW, thumb: knurled thumb hd; stainless steel; #12-24 thd 19/32″; screw length ⅝″ under hd; ⅝″ diam hd x ¼″ thk, ½″ diam shoulder $\frac{5}{16}$″ thk	Fastens polar relay clamp to post			CRL: Dwg # MM4585	W-72755		2	128	0	0	2
	SHAFT, roller: stainless steel; no dimension of this item is greater than one inch; #12-24 thd one end to screw into retainer	Mounts rollers on cabinet and chassis			CRL: Dwg # MM4583	W-72757		8	129	0	0	8

TABLE 6—3. COMBINED PARTS AND REPAIR PARTS LIST

PARTS									SPARE PARTS			
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY TYPE) NUMBER	NAVY STANDARD STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR DWG AND PART NO.	ALL SYMBOL DESIG. INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	EQUIP.	TENDER	STOCK
	SPECIAL HARDWARE (Continued)											
	SPACER: brass, cad pl; 5/16″ OD x 0.169″ ID x 1/2″ thk	Used for term bd mtg			CRL: Dwg # MM4582	W-72753		12	130	0	0	12
	SPACER: stainless steel; 7/16″ OD x 0.221″ ID x 0.040″ thk	Used for mtg cabinet rollers			CRL: Dwg # MM4583	W-72759 -1		4	131	0	0	4
	SPACER: stainless steel; 7/16″ OD x 0.221″ ID x 0.115″ thk	Used for mtg chassis rollers			CRL: Dwg # MM4583	W-72759 -2		4	132	0	0	4
	TERMINAL, lug: spade type; phos bz, hot tin dip; for #16 AWG wire; 1 3/8″ lg x 3/8″ wd x 1/32″ thk; two 3/16″ diam holes on 5/16″ ctrs; solder connects to wire	p/o W-101 and W-102			AF: #1841-L-28 (Spec)	L-70210		13	133	0	0	13

TABLE 6—4. CROSS REFERENCE PARTS LIST

JAN TYPE	SYMBOL	JAN TYPE	SYMBOL	JAN TYPE	SYMBOL
CE32F160Q	C-115AB	RC20BF105J	R-123	RC30BF105J	R-142
CE33F200M	C-103ABC	RC20BF106K	R-157	RC30BF393K	R-117
CE33F300J	C-101ABC	RC20BF152K	R-174	RC40BF153K	R-138
CE63F200J	C-116	RC20BF153K	R-106	RC40BF201J	R-175
CM35B103K	C-102	RC20BF201J	R-101	RC40BF223K	R-149
CM35D362G	C-111	RC20BF222K	R-152	RC40BF332K	R-177
CP29A1EF104M	C-108	RC20BF223K	R-108	RC40BF471K	R-127
CP69B1EF504V	C-109	RC20BF224K	R-107	RP101FD352KK	R-133
CP69B5EF104L	C-106ABC	RC20BF332K	R-166	RP101FD502KK	R-163
MR35W103SPEC	M-101	RC20BF333K	R-167	RW31F122	R-136
RA20A1SA152AK	R-146	RC20BF334K	R-111	RW31F801	R-162
RA20A2FD501AK	R-128	RC20BF335K	R-160	RW32F312	R-172
RA25A1SA153AK	R-147	RC20BF391J	R-148	RW33F502	R-161
RB11B10ROOF	R-130	RC20BF472K	R-137	SO10M	XV-103
RB11B355ROF	R-132	RC20BF473K	R-143	ST23K	S-101
RB11B850ROF	R-171	RC20BF474K	R-104	OC3/VR105	V-109
RB11B1000RF	R-134	RC20BF563J	R-122	1N43	CR-101
RC20BF102K	R-151	RC20BF681K	R-120	5Y3GT	V-107
RC20BF103K	R-121	RC20BF821J	R-103	6AQ5	V-103
RC20BF104K	R-105	RC20BF821K	R-144	12AU7	V-101

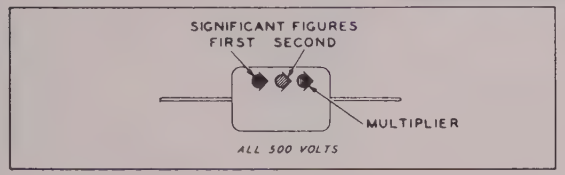
TABLE 6—4. CROSS REFERENCE PARTS LIST

NAVY TYPE	SYMBOL	ARMY-NAVY TYPE	SYMBOL	
-TB-11	E-102	AN3057-8(8C)	H-107	
-28001	O-103A	AN3057-10(8C)	H-106	
-28032-1R5	F-101	AN3102-16S-1SH(8C)	J-108	
-28032-3	F-103	AN3102-18-8PH(8C)	J-107	
-291724	O-102	AN3108-16S-1PH(8C)	J-110	
-291725	K-101	AN3108-18-8SH(8C)	J-109	
-291726	O-101			
-304772	T-105			
-304773	L-102			
-304774	T-101			
-304775	T-102			
-304776	T-104			
-304777	T-103			
-472403	L-101			
-491853	XV-101			
-49435	J-102			
-49496	H-103			
-49557-A	J-103			
-49557-A	XV-107			
-49679	H-101			
-49810	J-101			
-53550	Z-101			
-53551	Z-102			
-632395-K10	R-150			
-637200	E-101			

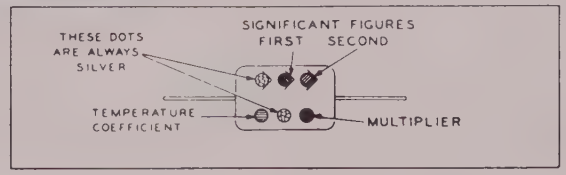
TABLE 6—5. APPLICABLE COLOR CODES AND MISCELLANEOUS DATA

CAPACITOR COLOR CODES

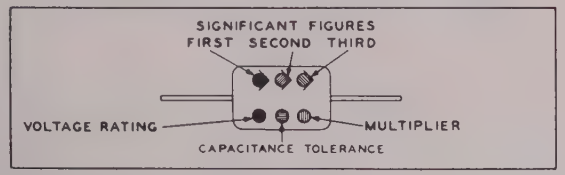
RMA 3-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



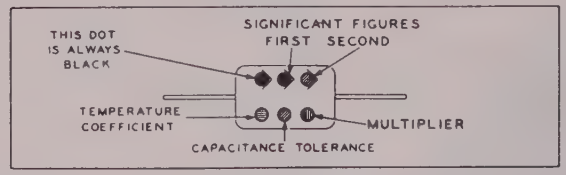
JAN 6-DOT COLOR CODE FOR PAPER-DIELECTRIC CAPACITORS



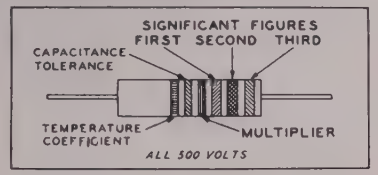
RMA 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



JAN 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS

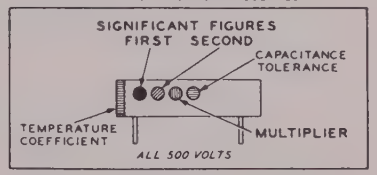


RMA COLOR CODE FOR TUBULAR CERAMIC-DIELECTRIC CAPACITORS



JAN COLOR CODE FOR FIXED CERAMIC-DIELECTRIC CAPACITORS

RADIAL TYPE NON-INSULATED



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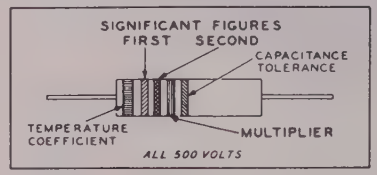


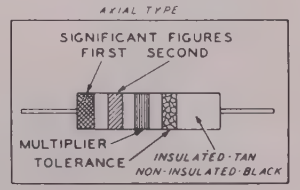
RMA: RADIO MANUFACTURERS ASSOCIATION
JAN: JOINT ARMY-NAVY

RESISTORS		CAPACITORS						
				MULTIPLIER				
TOLERANCE	MULTIPLIER	SIGNIFICANT FIGURE	COLOR	RMA MICA AND CERAMIC-DIELECTRIC	JAN MICA AND PAPER-DIELECTRIC	JAN CERAMIC DIELECTRIC	VOLTAGE RATING	TEMPERATURE COEFFICIENT
	1	0	BLACK	1	1	1		A
	10	1	BROWN	10	10	10	100	B
	100	2	RED	100	100	100	200	C
	1,000	3	ORANGE	1,000	1000	1000	300	D
	10,000	4	YELLOW	10,000			400	E
	100,000	5	GREEN	100,000			500	F
	1,000,000	6	BLUE	1,000,000			600	G
	10,000,000	7	VIOLET	10,000,000			700	
	100,000,000	8	GRAY	100,000,000		0.01	800	
	1,000,000,000	9	WHITE	1,000,000,000		0.1	900	
5	0.1		GOLD	0.1	0.1		1000	
10	0.01		SILVER	0.01	0.01		2000	
20			NO COLOR				500	

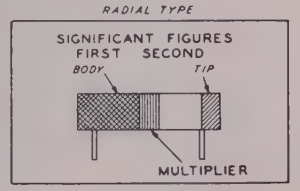
RESISTOR COLOR CODES

RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE

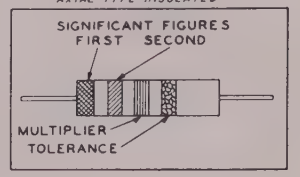


RADIAL TYPE



JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE INSULATED



RADIAL TYPE NON-INSULATED

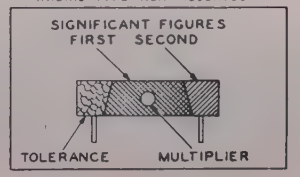


TABLE 6—6. LIST OF MANUFACTURERS

CODE NO.	BUSHIPS DESIG.	NAME	ADDRESS
AA		Accurate Products Co.	Culver City, Calif.
AC		Croname, Inc.	Chicago, Ill.
AD		Fahnestock Co.	Long Island, N. Y.
AE		General Laminated Products Co.	Chicago, Ill.
AF		Patton-MacGuyer	Providence, R. I.
AH		Miller Nameplate Co.	Oakland, Calif.
CAIS	CAIS	Birtcher Corp., The	Los Angeles, Calif.
CAO	CAO	Ward-Leonard Co.	Mt. Vernon, N. Y.
CAVK	CAVK	Burlington Instrument Co.	Burlington, Iowa
CAYT	CAYT	Allen Mfg. Co.	Hartford, Conn.
CAYU	CAYU	Barry, L. N., Mfg. Co.	Cambridge, Mass.
CAYZ	CAYZ	Dial Light Co. of Amer. (DIALCO)	New York, N. Y.
CBIS	CBIS	Burnell and Co.	Yonkers, N. Y.
CBNC	CBNC	Triad Transformer Mfg. Co.	Los Angeles, Calif.
CBV	CBV	Fast Co., John E.	Chicago, Ill.
CBZ	CBZ	Allen-Bradley Co.	Milwaukee, Wisc.
CEB	CEB	Eby, Hugh H., Inc.	Philadelphia, Penna.
CG	CG	General Electric Co.	Schenectady, N. Y.
CHH	CHH	Arrow-Hart and Hegeman Elect. Co.	Hartford, Conn.
CIR	CIR	International Resistance Corp.	Philadelphia, Penna.
CLF	CLF	Littelfuse Laboratories, Inc.	Chicago, Ill.
CMA	CMA	P. R. Mallory Co.	Indianapolis, Ind.
CMF	CMF	Electro-Motive Mfg. Co.	Willimantic, Conn.
CMG	CMG	Cinch Mfg. Co.	Chicago, Ill.
CPH	CPH	American Phenolic Corp.	Chicago, Ill.
CRC	CRC	RCA Mfg. Co. (Radiotron Div.)	Harrison, N. J.
CRL	CRL	Remler Co., Ltd.	San Francisco, Calif.
CRY	CRY	C. P. Clare and Co.	Chicago, Ill.
CSF	CSF	Sprague Specialties Co.	North Adams, Mass.
CSI	CSI	Sigma Instruments, Inc.	Boston, Mass.
CSL	CSL	Solar Mfg. Co.	North Bergen, N. J.
CSM	CSM	Shallcross Mfg. Co.	Collingdale, Penna.
CTC	CTC	Chicago Telephone Supply Co.	Elkhart, Ind.
CUT	CUT	United Transformer Corp.	New York, N. Y.
CV	CV	Weston Elec. Instr. Corp.	Newark, N. J.
CW	CW	Western Electric Co.	New York, N. Y.